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No. 1

UNITED STATES ATOMIC ENERGY COMMISSION

Nuclear Science Abstracts

Vol. 1 No. 1
July 15, 1948

Technical Information Division, Oak Ridge Directed Operations
Oak Ridge, Tennessee

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NUCLEAR SCIENCE ABSTRACTS

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Addendum

Nuclear Science Abstracts

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The following statement is to be considered part of the cover of the above publication:

"Issuing of these Abstracts does not constitute authority for declassification of any documents."

Errata

It was erroneously indicated in Volume I, Number 1 of Nuclear Science Abstracts, that the documents corresponding to the following abstracts would be for sale by the Atomic Energy Commission:

Abstracts Numbers 16, 43, 44, 60, 88, 89, 122, 152, 174 and 176.

ABSORPTION AND SCATTERING OF RADIATION

1 Back-Scattering of Pu^{239} Alpha Particles from Platinum, by B. B. Cunningham, A. Ghiorso, and J. C. Hindman. AECD-2026 (ANL-JJK-14B-134), January 1944, decl. June 1, 1948. 7p. (To be included in the NNES-MPTS)

The apparent specific activity of Pu^{239} spread as a thin layer on platinum has been found to be 4 per cent higher in a 50% geometry counter than in a 0.04% geometry counter. The difference is attributed to low-angle back scattering of alpha particles by platinum. Qualitative support for this hypothesis is furnished by the observation that identical weights of Pu^{239} show a 3 per cent lower counting rate in a 50 per cent geometry counter when mounted on quartz, as compared to similar samples mounted on platinum.

2 Theoretical Calculations Concerning Backscattering of Alpha Particles, by J. A. Crawford. AECD-2034 (CC-1342; A-1875), February 1, 1944, decl. June 8, 1948. 18p. (To be included in the NNES-MPTS)

Calculations indicate that alpha particles with a range of 3.68 cm in air are backscattered from a platinum sample mounting to the extent of 3 to 3.5%. The calculations are based upon Geiger's multiple scattering data. Variations of backscattering with range and with substrate are also calculated.

3 The Beta-Spectrum of S^{35} and the Mass of the Neutrino, by C. Sharp Cook, Lawrence M. Langer, and H. Clay Price, Jr. Physical Review 73, p. 1395, June 1, 1948.

Using sources prepared from high specific activity material obtained from Oak Ridge, the momentum distribution of the negatrons emitted by S^{35} has been investigated in a large, high resolution, shaped field magnetic spectrometer employing a 40-cm radius of curvature. Measurements were made on sources of several thicknesses on backings of 0.5 mg/cm^2 Nylon and 0.03 mg/cm^2 Zapon. The Zapon counter window transmits electrons down to 2.0 Kev. Within the limits of experimental error, the authors conclude the mass of the neutrino is less than one per cent that of the electron.

4 Cloud Chamber Investigation of Straggling of Short-Range Particles Produced by Slow Neutron Reactions, by J. K. Boggild. Nature 161, p. 810-811, May 22, 1948.

A study of the range distributions of particles produced by slow neutron disintegrations of gas nuclei in a cloud chamber was made to determine the straggling coefficient. The distribution of total ranges are shown in histograms. The first shows the distribution of total ranges of 54 tracks produced by the reaction $^{14}N(n,p)C^{14}$, the second show the distribution of total ranges of 926 tracks produced by the reaction $^{10}B(n,a)^{7}Li$.

ABSORPTION AND SCATTERING OF RADIATION

5 On the Gamma Radiation from Polonium and from Lithium Bombarded with Alpha Particles, by Kai Siegbahn and Hilding Slatis. Arkiv för Matematik, Astronomi och Fysik 34A, No. 15, p. 1-12, 1947.

Absorption measurements in lead of the gamma radiation from polonium revealed that the radiation contained only one component and that it had an energy of about 0.8 Mev. The study of the photo- and Compton-spectrum of the gamma radiation from polonium in the beta spectrograph of high light intensity and of the lens type showed that the gamma radiation was monoenergetic and that the energy of the gamma quanta amounted to 0.773 Mev. The photo- and Compton-spectrum of gamma radiation from lithium, which was bombarded with alpha particles from polonium, showed that lithium, too, emitted only one gamma line and that the energy of this line was 0.462 Mev.

6 Precision Wave-Length and Energy Measurement of Gamma-Rays from Au^{198} with a Focusing Quartz Crystal Spectrometer, by Jesse W. M. DuMond, David A. Lind, and Bernard B. Watson. Physical Review 73, p. 1392-1394, June 1, 1948.

Using a precision focusing curved crystal x-ray and gamma-ray spectrometer (2-meter focal length) constructed at the California Institute of Technology, the 0.41 Mev gamma-ray line from a 1-curie source of the artificial radioactive isotope of gold, Au^{198}, of half-life 2.7 days has been studied. Preliminary values of wave-length and energy are reported. The recommended preliminary energy value is given as 0.4112 ± 0.0001 Mev.

7 Proton-Proton Scattering at 7 Mev, by I. H. Dearnley, C. L. Oxley, and J. E. Perry, Jr., Physical Review 73, p. 1290-1306, June 1, 1948.

Scattering experiments have been performed with protons from the cyclotron scattered in hydrogen gas. Photographic plates were used in a camera which recorded simultaneously individual protons scattered at angles from 10.5° to 45°. 5000 tracks were counted in each of nine narrow angular ranges to give good statistical accuracy. An experimentally determined correction was necessary due to proton penetration of the edges of the slits which admitted scattered protons to the photographic plates. The energy of the protons was determined by magnetic deflection and from ionization ranges. Analysis of the results shows an $\underline{s}$ phase shift somewhat lower than that predicted by extrapolation of the earlier low energy data as analyzed in terms of square well, Gauss, and meson potentials. On the assumption of central $\underline{p}$ wave scattering the results are fitted by a $\underline{p}$ phase shift of -0.22° which corresponds to scattering from a repulsive square well with interior Coulomb potential, range $\underline{e}^2/mc^2$ and height 2.2 Mev. Extending the Rarita-Schwinger neutron-proton interactions to the proton-proton system for a prediction of tensor $^3\underline{P}$ wave scattering, we find that the experimental results are reconcilable with the "symmetrical" theory and with the "charged" theory as formally constructed by them. The "neutral" theory gives $3\underline{p}$ scattering in definite disagreement with the experimental results.

ABSORPTION AND SCATTERING OF RADIATION

8 The Scattering of Protons by Protons and the Meson Field of the Proton, by J. K. Lubanski and C. de Jager. Physica 14, p. 8-14, January 1948.

New calculations are made on the scattering of protons by protons with several values of the potential energy of the proton, this energy being assumed to be the meson potential. The results of these calculations are compared with the available experimental material. They indicate a rather high value for the meson mass to be connected with the potential field of the proton (M_{max} = 300 m ± 30 m). This is in accordance with former calculations of Breit et al, and in disagreement with direct determinations of the mass of the meson, this being about 220 m.

9 A Study of RaE β-Spectrum from Absorption Measurements, by N. N. Das Gupta and A. K. Chaudhury. Indian Journal of Physics 22, p. 27-38, January 1948.

A new method for investigating the shape of the β-ray spectrum from absorption measurements has been described. The β-ray spectrum of RaE has been studied with the help of this method. It was found the RaE β-ray spectrum as deduced from absorption measurements agrees with the K. U. form but deviates from the original Fermi distribution. This shows that the correction factor which must be applied to the original Fermi expression in order to take into account the fact the RaE is a forbidden type of β-disintegration, is proportional to $(W_O - W)^2$.

ATOMIC POWER

10 Atomic Energy, by M. Cahan. Memorial de l 'Artillerie Francaise 21, No. 80, p 274-367, 1947.

This paper is based on lectures given at the Ecole d'Application du Genie Maritime in 1946. After a brief survey of the general modern trends in physics, the author deals with the theories and principles of electronics, with atomic and nuclear structure and the fission of uranium, and the various uses and applications of atomic products.

11 Atomic Energy and American Industry, by David E. Lilienthal. Combustion 19, No. 5, p. 34-37, 1947.

General discussion of problems to be solved before useful atomic power is produced. At least 8-10 years will lapse before a practical demonstration plant is in operation.

12 The Science and Engineering of Nuclear Power, by Charles D. Coryell, et al. Cambridge, Mass., Addison Wesley Press, 1948. 501 p 1.

BIOLOGICAL EFFECTS OF RADIATION

13 Changes in Mean Blood Levels of Metallurgical Laboratory Employees during the First Year of Employment, as Related to Working Conditions, by N. Pearlman and G. A. Sacher. AECD-2030 (CH-3865), June 1946, decl. June 3, 1948. 7p. (To be included in the NNES-MPTS)

Mean levels of several blood elements were investigated for a control group and for groups exposed to radiation and uranium toxicity hazards in the Metallurgical Laboratory at six months and one year after employment. No significant decrease in mean level was found for any blood element. Lymphocytes of the groups exposed to radiation hazards and those of the metal working groups increased significantly after employment. The increase of lymphocyte count in hazard groups in excess of a slight increase in the control group is on the borderline of significance ($p = 0.05$). Thus it is possible that working in the presence of radiation or metal hazards somehow brings about slight lymphocytosis. Individual daily monitoring indicates that the average measured exposure is less than 0.1 r per day for all individuals in these groups.

14 The Acute Radiotoxicity of Injected Na^{24} for Mice and Rats; Part II. The Effect of Na^{24} on the Leucocytes of the Peripheral Blood of Mice, by L. O. Jacobson and E. L. Simmons. AECD-2036 (CH-3857), June 1946, decl. June 9, 1948. 16p. (To be included in the NNES-MPTS)

Groups of male mice of the ABC and CF-1 strains were injected intraperitoneally with Na^{24} as the chloride in doses of 12, 23, 47, 65, and 90 μc/g. Leucocyte counts and differential blood smears were made on all animals before injection of the radioactive isotope and at intervals thereafter; through 10 days in one experiment and through 15 days in another.

A moderate to severe leucopenia followed the injection of all the above doses except the 12 μc/g. Death of the animals in the groups which received 47, 65, or 90 μc/g occurred before the eighth day. The number of neutrophils per cubic millimeter rose slightly for 3 days in the group which received 90 μc/g. No further sampling was possible in this group because of the death of all the animals. No reduction of neutrophils followed the injection of 23 μc/g in one experiment; 23, 47, and 65 μc/g produced a marked neutropenia in another experiment. Lymphopenia occurred in all groups of animals which received 23, 47, 65, or 90 μc/g and continued until sampling was discontinued or until death of the animals.

15 The Effects of Injected Yttrium^{91}, Part VIII. Hematological Effects, by L. O. Jacobson and E. L. Simmons. AECD-2037 (CH-3859), June 1946, decl. June 11, 1948. 30 p. (To be included in the NNES-MPTS)

Radioactive yttrium (Y^{91}) was administered by gavage to rats in single acute doses of 5, 10, and 20 μc/g. Daily doses of from 0.3 to 2.0 μc/g were administered to other rats, and at some dose levels treatment was continued up to 178 days.

A single dose of 20 μc/g produced a marked initial elevation in erythrocytes and hemoglobin, followed by an erratic anemia due to bleeding. A 75 per cent reduction in lymphocytes occurred within 3 days, but these elements reached a normal value by 42 days. The heterophil values after this dose were extremely variable. A dose of 10 μc/g produced a temporary lymphopenia and an erratic heterophilia

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only. No hematological effect was observed after single doses of less than 10 μc/g.

The daily gavage of Y^{91} in amounts from 0.3 to 2.0 μc/g produced no anemia. A sustained heterophilia was present in all groups receiving daily treatment. In one experiment a moderate lymphopenia, which reached its maximum at 60 days, was produced by the daily treatment of 0.3 and 1.0 μc/g but the lymphocytes gradually recovered to normal values by 90 days even though yttrium administration continued through 178 days.

In another experiment, daily ingestion of 0.3, 1.0 μc/g produced a lymphopenia which reached its maximum at 98 days. By 14 days after the discontinuation of Y^{91} gavage (at 95 days) the lymphocyte values had returned to normal levels. It is suggested that the lymphopenia described above results from the local effect of β-radiation on the lymphatic tissue of the gastro-intestinal tract.

No significant morphological change in the nucleated cells or erythrocytes occurred after singly or chronically administered doses of ingested Y^{91}.

16 Late Effects of Radium and Plutonium on Bone, by M. A. Bloom and W. Bloom. AECD-2053 (ANL-HDY-496), April 1948, decl. June 15, 1948. 36p. (For publication in a suitable journal). For sale by AEC.

Radium injected into mice intraperitoneally at dose levels of 0.3 and 0.03 μc/g, and plutonium, 0.03 and 0.003 μc/g given intravenously, produce an overgrowth of bone in the femurs and vertebrae. In the femur this overgrowth begins in the distal metaphysis and is more extensive there than in epiphysis or shaft. This atypical bone, surrounded by gelatinous marrow, fills the metaphysis and encroaches on the marrow of the shaft, which is also invaded by new bone from the endosteum, and, in the extreme cases, the two processes combine in some areas to obliterate the marrow.

The bone formed after radium treatment is atypical and fibrous, and much of it becomes devitalized. The cortical bone of the shaft also contains many empty lacunae. After plutonium treatment the newest bone is also fibrous, but the greatly thickened trabeculae of spongy bone becomes progressively more compact, although the extremely irregular arrangement of lamellae and osteocytes distinguishes them from normal bone. Empty lacunae are fewer than after radium.

Early changes of an atypical proliferative nature were seen in a 3-month specimen after radium and in a 7-month specimen after plutonium, and may represent early sarcoma or a predisposing state.

Resorption of the necrotic bone does not seem to have occurred. Infraction of the marrow was seen in two of the radium- and one of the plutonium-injected animals. The changes in the vertebrae are essentially like those in the femurs.

17 Annual Review of Physiology, ed. by V. E. Hall. Stanford, Calif., Annual Review, Inc., 1948.

The chapter on "Physiological Effects of Radiant Energy," by R. L. Dobson and J. W. Lawrence brings out the highlights of recent developments in this field. Emphasis is placed on short wave length electromagnetic radiations - X-rays and gamma rays; and on particulate radiations - alpha rays, beta rays, neutrons and fission fragments.

BIOLOGICAL EFFECTS OF RADIATION

18 Atomic-Bomb Radiation. Mechanical Engineering 70, p. 546, June 1948.

The radiation effects produced by an atom bomb are considered. The known kinds of penetrating radiation which can be expected within the immediate area of a blast are: gamma radiation, neutron beams, beta rays and alpha rays. The types of burns, physical damage to persons and food and water are also considered.

19 The Biological Effect of Injected Radioactive Isotopes, by G. Schubert and W. Riezler. Strahlentherapie 76, p. 407-416, 1947.

20 Certain Aspects of the Action of Radiation on Living Cells, ed. by F. G. Spear. British Journal of Radiology, Supplement No. 1, 1947.

The British Journal of Radiology has published in the form of a Supplement the Report of the London Conference arranged by the British Institute of Radiology to consider the action of radiation on living cells.

The introductory paper by L. H. Gray deals with the distribution of the ions resulting from the irradiation of living cells by beta and gamma rays, X-rays, neutrons, and alpha particles. The remaining papers constitute four groups, taking up the effects of radiation, respectively, on viruses, dilute aqueous solutions, chromosomes, and germ cells with special reference to man.

With the supplement comes a four-page glossary of biological, physical, and chemical terms which should be valuable to those less familiar with experimental studies of the type presented here.

21 Change in Cutaneous Sensitivity to X-rays During Experimental Hyperglucemia in Rabbits, by F. Baclesse and J. Loiseleur. Comptes Rendus Des Seánces de la Société de Biologie 141, p. 743-745, 1947.

Intramuscular injection of a near-lethal dose of glucose 45 minutes previously to X-ray irridiation reduced the sensitivity of the skin to x-rays.

22 The Effect of Beta Rays on Cells Cultivated In Vitro, by Ilse Lasnitzki. British Journal of Radiology 21, p. 265-269, June 1948.

Tissue cultures of avain fibroblasts were exposed to a dose of 1000 r of pure β-rays from uranium UX-1. Alteration in mitosis and the production of abnormal mitotic and degenerate cells were examined quantitatively for a period of 24 hours following irradiation. A steep fall in mitosis, the appearance of abnormal mitotic figures, and degenerate cells were observed shortly after exposure. This was followed by a return of mitotic activity accompanied by more abnormal mitosis and cell degeneration. Mitotic recovery was half the normal value at the end of the observation period. A comparison with changes seen in tissue cultures treated with the same dose of X-rays shows that the effect is qualitatively similar, and that the total damage produced is of the same order in both cases, but the time relation differs markedly in the two experiments. β-irradiated cultures show the greatest

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effect shortly after exposure and an early recovery, while after X-rays the radiation effect is delayed and recovery is slow.

23 Effect of Large Dosages of Irradiation on Gastric Acidity, by I. V. Brick. New England Journal of Medicine 237, p. 48-51, 1947.

No definite pattern of effect on gastric acidity is seen after radiation injury; there was no effect after 2 months. Radiation has no place in the treatment of peptic ulcers since it may produce perforation and hemorrhage or no change.

24 The Effect of Radiation on Hemopoiesis; Is There Any Indirect Effect, by John S. Lawrence, William N. Valentine, and Andrew H. Dowdy. Journal of Hematology 3, p. 593-609, May 1948. (MDDC-326).

The general aim of the investigations has been to obtain evidence for or against "indirect" radiation effects. To this end, twenty-six successful cross circulation experiments (carotid to carotid anastomosis) have been performed between normal cats and radiated cats. Cross circulation was established in most instances at some specified time interval after the radiation of one partner. All intervals up to eighty-two hours after radiation of one partner were covered. In seven experiments cross circulation was established and then one animal radiated while the other was shielded. These were considered the most critical experiments of the group.

Detailed data on leukocyte and lymphocyte counts in the normal animals obtained during an approximately twenty-eight day period of follow-up are presented. These data are not considered to support the thesis of indirect effects peculiar to radiation. A trend toward slightly lowered absolute lymphocyte counts in normal animals after cross circulation was not considered significant, and in no instance did leukopenia develop in the normal animal. The literature is reviewed and discussed.

25 The Effect of Radioactive Phosphorus Upon a Suspension of Escherichia Coli, by Clarence F. Schmidt. Journal of Bacteriology 55, p. 705-709, May 1948.

Radioactive phosphorus (P^{32}) added to a suspension of Escherichia coli in phosphate buffer has a definitely lethal effect upon the cells that in a general way is related to the initial concentration. Complete sterilization of the suspension was not obtained in the highest concentration tested. The survivor curve indicated a more rapid rate of killing during the first time interval, and the existence of a small percentage of the cells that were more resistant and survived to the end of the experiment. The present experiment does not suggest in any way the possibility of the application of radioactive materials to the sterilization of food products.

BIOLOGICAL EFFECTS OF RADIATION

26 Effects of X-Radiation on Sodium Thymus Nucleate, by B. Taylor, J. P. Greenstein and A. Hollaender. Archives of Biochemistry 16, p. 19-31, January 1948.

The effect of X-rays on aqueous solutions of sodium thymus nucleate is apparently to break up the long, fibrous particle into shorter fragments of variable dimensions. The passage from a state of monodispersion to a state of wide polydispersion continues, after the actual irradiation has stopped, for several hours until a new equilibrium is reached. The extent of the change, or the level of that new equilibrium depends on the dose of roentgens delivered and is independent of the time over which that dose is given. The chemical properties and susceptibility to desoxyribonuclease-Mg^{++} of sodium thymus nucleate are essentially independent of the state of polymerization or dispersion as altered by X-rays.

27 Effects of X-Ray Irradiation on the Development of Ovarian Tumors in Intrasplenic Grafts in Castrated Mice, by Min Hsin Li, W. U. Gardner, and Henry S. Kaplan. Journal of the National Cancer Institute 8, p. 91-98, December 1947.

Granulosa-cell tumors, luteomas, or mixed tumors developed in irradiated (400 r), intrasplenic ovarian grafts in seven of nine castrated female mice and in all of eight castrated male mice. The incidence and time of origin of these tumors were not modified by irradiation. Neither ova nor normal ovarian follicles were observed in any of the irradiated grafts. Roentgen irradiation of the hypophysis and adjacent tissues (400 r) did not inhibit the formation of the intrasplenic ovarian tumors which developed in 9 of 12 mice so treated. Ovaries irradiated in vitro (200 r) and subsequently grafted into the spleens of castrated hosts gave rise to tumors, but with a lower incidence than did grafts irradiated in vivo.

28 The Effects of X-Rays on the Mitotic Activity of Mouse Epidermis, by Norman P. Knowlton, Jr., Louis H. Hempelmann, and Joseph C. Hoffman. Science 107, p. 625, June 11, 1948. (AECD-1808).

The mitotic index of the skin of the mouse has been studied as a means of measuring the biological effect of X-rays at doses of 35 and 325 r. As little as 35 r of 250 kv X-rays produce a drop in the mitotic index to zero within one to two hours after radiation. The number of mitoses returned to normal within a few hours after radiation. The time required for the number of mitoses to return to normal increases greatly with increased radiation dosage. It is believed that the time required for the mitotic index to return to normal will provide an excellent basis for rating the biological effectiveness of radiation of different types and different energies. With 325 r of X-rays the mitotic index required six days to return to normal and continued to increase to more than twice normal. This is believed to be an over compensation phenomena which may also be used as an index of radiation damage.

BIOLOGICAL EFFECTS OF RADIATION

29 Experimental X-Irradiation of the Rat Thyroid, by A. E. Bender. British Journal of Radiology 21, p. 244-248, May 1948.

Treatment of the thyroid of rats with doses of X-rays ranging from 50-5000 r produces no change in their oxygen consumption, nor in the histological appearance of the glands in (a) mature male rats; (b) young growing rats; (c) mature animals in which the gland had been rendered hyperplastic by oral administration of thiouracil. Doses greater than 5000 r invariably resulted in death of the animals 9-10 days later, which could be delayed or prevented by the subcutaneous administration of glucose-saline. Although death was apparently due to insufficient intake of fluid, no cause for this was found.

30 Immediate and Delayed Biochemical and Biological Effects of Irradiation on Animal Tissue, by Hardin B. Jones and others. (Status Report No. 3, June-December 1947). Berkley, University of California, 1947. (TIP U 547).

Adult rats were injected intraperitoneally with 14, 170, and 500 microcurie of I^{131}. Animals were sacrificed after injections. The I of the thyroid gland was fractionated into organic and inorganic; both chemical and radioactive measurements were made. The gland began to lose I rapidly 24 hours following injection of 500 microcurie of I^{131}. The effect of irradiation upon the thyroxine-I metabolism was insignificant up to dosages of 35,000 β-r equivalents. Thyroxine was formed as long as the cells were intact. The colloidal substance of the thyroid was particularticularly sensitive to irradiation. Its disappearance was one of the first changes noticed, but in spite of its absence synthesis of thyroxine took place. Methods for localizing radioactive compounds in the liver, spleen, and bone marrow are summarized.

31 Influence of Dose Fractionation on the Lethal X-Ray Effect Produced by Total Body Irradiation in Mice; a Preliminary Note, by F. Effinger. Radiology 49, p. 238-241, August 1947.

Data are presented on the lethal effect upon mice of total body irradiation by a single dose, and a comparison is made with the effect of the same dose fractionated, 252 white male mice having been irradiated with 1,000, 500, and 400 r in air. Fractionation consisted in giving a dose of 100 r on successive days. The results are given in graphs, and show that there was in every case a reduced mortality rate after the fractionated dose, as compared with the mortality rate after the same dose given as a single exposure. The effect was found to be most pronounced for that dose which, when given unfractionated, resulted in the lowest mortality rate - in this case the 400 r dose. The author considers the result significant from the point of view of the physician, since there is here some suggestion that the living organism may tolerate as general radiation, multiple applications of a dose which is high enough to have an effect upon neoplastic tissue.

32 Lethal Effect of Cosmic Ray Showers on the Progeny of Animals. Experientia 4, p. 31-33, January 15, 1948.

The biological effect of cosmic ray showers on the fertility of Angora rabbits and white mice was studied. A summary is given of the results of similar experiments with domestic rabbits previously performed by J. Eugster and V. F. Hess. The conditions involved were abnormal in some respects,

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so the lethal effect and sterility found were considered questionable. Experiments with Angora rabbits were performed in Budapest (110 m. above sea level) in an Angora rabbit farm under state control, where several hundred rabbits were bred. 16 mm of lead (the most efficient thickness for generating cascade showers) was placed above the one inch thick wooden cover of two of the usual cages, and the control animals were kept within the same locality. The control animals were always sister females, belonging to the same litter, and they were copulated with the same male as the test animals. They gave birth in every case to normally developed young. Out of the data collected it may be inferred that neither sterility nor a permanent change in the females, which would affect a later delivery, seems to prevail. However, there appears to be good evidence for the existence of a lethal effect, resulting most probably from the influence of cosmic ray showers upon the embryos.

Experiments were conducted with white mice to confirm the lethal effect of the cascade showers. The animals were kept in a glass box 60 x 130 cm basis and 40 cm height and installed in 14 separate cages with aluminium walls, asbestos base, and covered with a wire net. In one set, lead of 16 mm thickness was placed over half the box at a height of 10 cm above the animals, thus only about half the animals were kept under lead. Within three months 21 animals kept under lead delivered 98 living and 4 dead offspring. Out of the 98 living young 64 perished within a week after their birth, the mean loss being $71 \pm 6\%$. Out of the animals not kept under lead, 16 delivered 93 living and 1 dead young in the course of the same three months. 23 of the 93 died within a week after birth, the mean loss being $22 \pm 9\%$. The loss difference $49 \pm 11\%$ represents the lethal effect due to the lead layer.

33 Local Skin Damage by Deuterons, by G. Schubert and W. Riezler. Naturwissenschaften 33, p. 285-286, 1946.

Irradiation of the skin of guinea-pigs with deuterons from a distance of 16 cm for 4 to 90 seconds produces changes in the epithelium and stratum papillare up to a depth of 0.11 mm without any obvious local reaction. These changes are shown by increased staining properties and homogenisation of connective tissue. The various layers are difficult to recognize, although the nuclear structures are still intact. Four weeks later, the outer epithelium is completely regenerated, but there is atrophy of the affected area and the cellular connective tissue extends almost to the surface. The hemogenisation of tissue is explained by the destruction of the protein molecules, resulting in local atrophy.

34 Neutron Effects on Animals, by the Staff of the Biochemical Research Foundation. Baltimore, Williams and Wilkins, 1947. 198p.

This book is a collection of scientific papers concerned with special chemical, physiological, and pathological studies of the effects exerted by neutrons on bacteria, plants and animals.

BIOLOGICAL EFFECTS OF RADIATION

35 **Pathologic Effects of Ionizing Radiations and Radioactive Materials, by A. M. Brues. Biochemical Journal 42, p.XXII, 1948. (Abstract of paper presented at meeting of Biochemical Society).**

Certain purely chemical effects of ionizing radiations are understood. These include the dissociation of water into H and OH radicals and the inhibition of certain enzymes such as those containing sulphydryl groups. In addition to these proximate effects, various forms of genetic and cell damage have been extensively studied. The relation of these changes to most clinical radiation effects remains largely to be established.

In acute lethal radiation exposure in mammals, an immediate response is seen corresponding to clinical X-ray sickness. Susceptible animals will show hypertension, vomiting, or erythema of the skin. By the second day, acute symptoms have largely abated, but there is a marked decrease in circulating white cells which continues until death. During the ensuing week, animals refuse food and water and lose weight. There is increasing anaemia, increased plasma and extracellular volume, accelerated sedimentation rate, increased renal excretion of phenol red, and decreased levels of blood non-protein nitrogen, urea and polypeptides. Histologic damage is most marked in the blood-forming organs, gonads, and intestinal tract.

During the second week, the clotting time is greatly increased due to an over-abundance of circulating heparin; fever and subcutaneous oedema appear and death occurs, attended by loss of blood, bleeding into vital areas, such as the heart and central nervous system, ulceration of mucous membranes and a terminal shock-like state. A shift in the plasma protein pattern (increased beta and gamma globulin) has been seen in dogs, but is not specific for radiation sickness.

Later effects in surviving animals include anaemia, lymphoid atrophy, and in mice, an enhanced tendency to lymphoma. Chronic effects include decrease in life span, greying of hair and an increased tumor incidence.

Acute effects of absorbed radio elements generally resemble those of total body radiation. Their late effects depend upon localization of the element and, as in the case of radium, a great increase in bone tumors is seen after absorption of radiostrontium, as well as plutonium and many of the radioactive rare earths.

Since C^{14} has been shown to deposit in bone (Bloom, Curtis and McLean, 1947), the question is raised whether it may present a human hazard analogous to radium. An attempt has been made to consider the human tolerance on the basis of known facts and it is presently thought that a total human absorption in excess of 30 microcuries must be considered hazardous until further knowledge is gained regarding the retention of carbon administered in various forms. In the case of a hypothetical carbon compound, such as a steroid, which might remain localized in a very small organ, even this figure may need revision.

36 **Physical Basis for the High Skin Tolerance of Supervoltage Roentgen Rays, by J. G. Trump. Radiology 50, p. 649-656, May 1948.**

With supervoltage roentgen rays the ionization produced in the surface region is less than that available some distance below, and composed of electrons of relatively high average energy and therefore lower biological effectiveness. These considerations made possible an adequate physical explanation of the increased skin tolerance of high-energy radiation. This effect must disappear almost completely when the radiation beam has traversed a distance below the surface equal to the range of the highest-energy electrons which the beam can produce. Beyond this distance the electromagnetic radiation is

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always accompanied by the full complement of low-energy secondaries so that the average energy of the electron ionization is little different from that produced by low-voltage roentgen rays. Thus, for tissue lying deeper than the level of maximum ionization density, the biological effect per erg of energy absorbed should be closely the same throughout the roentgen-ray spectrum. Only at the entering skin should the biological effect become progressively less the higher the voltage.

37 Radiations and Cell Division, by A. C. Giese. Quarterly Review of Biology 22, p. 253-282, 1947.

A review with about 300 references, including chemical mechanism of cell division.

38 Some Hematologic Effects of Irradiation by William Bloom and Leon O. Jacobson. Journal of Hematology 3, p. 586-591 May 1948. (Summary of various MDDC's).

Extensive studies with acute and chronic application of externally originating ionizing radiations and internally deposited radioisotopes P^{32}, Sr^{89}, Y^{91}, Zr^{40}, Ba^{140}, La^{140}, Na^{24}, and elements Ra and Pu have failed to reveal evidence in the blood forming tissues and peripheral blood of a primary stimulation of hematopoiesis. However, secondary or "compensatory increases" in certain of the cellular constitutents of the peripheral blood were seen and were invariably preceded by a reduction. The initial leukocytosis (heterophil increase) which occurs in the first twenty-four hours after acute exposure to externally originating irradiations is probably a reaction to injury mediated through a mobilization rather than a new formation of blood cells. The abortive rise in heterophils, lymphocytes, and reticulocytes is likewise probably a result of frank injury. (TID)

39 The Theory of the Biological Effect of X-Rays, by L. Neu and V. Neu. Medical Woman's Journal 54, p. 17-23, 1947.

The permeability of cell membranes is increased after X-ray irradiation; unstable cell membranes have an increased sensitivity to X-rays. A hypothesis is advanced showing a close connection between the periodic behavior of the permeability of cell membranes and the recurring X-ray effect, erythema. The concentration of ions in a cell increases with irradiation time; the primary effect of X-rays is an irreversible poisoning of the living cell.

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40 Quarterly Report May 1947 to August 1947 (Biology Division), by A. M. Brues. AECD - 2024 (ANL-4078), August 1, 1947, decl. May 26, 1948. 172 p. (Disposition as required for use in research, development, or manufacturing work)

This document consists of a number of progress reports numbered AECD - 2024-A through AECD - 2024-P. These reports are individually abstracted below.

40-A Progress Report in Radiation Physics, by V. T. Clemens, S. S. Brar, and R. J. Moon. AECD - 2024-A, August 1, 1947, decl. May 26, 1948. 2 p.

Progress is reported on the following problems: surface dosage measurement of plutonium (Pu^{239}); absolute activities of P^{32}, Sr^{89}, Sr^{90} and C^{14}; and determination of radium in the body.

40-B Progress Report in Hematology; Part I, by S. P. Stearner. AECD - 2024-B, August 1, 1947, decl. May 26, 1948. 3 p.

The topics discussed are effects of folic on macrocytic anemia produced in rats by total-body X-irradiation, and effects of total-body X-irradiation on splenectomized rats.

40-C Progress Report in Hematology; Part II, by L. O. Jacobson, E. K. Marks, E. O. Gaston, and E. Skirmont. AECD - 2024-C, August 1, 1947, decl. May 26, 1948. 3 p.

Progress is reported on the following problems: re-determination of the 30 day LD_{50} for rabbits exposed to total-body X-radiation; effect of total-body X-irradiation on the whole blood coagulation time of the rabbit; and the effect of altered states of blood-forming tissue in radiosensitivity or resistance.

40-D The Effect of a Second Acute X-Ray Exposure on the Recovery of the Circulating Erythrocytes in Irradiated Rats, by S. P. Stearner. AECD - 2024-D, August 1, 1947, decl. May 26, 1948. 10 p.

Experiments on the rat exposed to acute doses of X-rays showed that although recovery was largely complete at 35 days, a small but significant difference in the erythrocyte count (between control and irradiated groups) persisted for about three months. It was expected that a second exposure to the same dose at this interval would produce more severe damage than did the first exposure.

White rats, about two months old at the start of the experiment, were divided into three groups and treated as follows:

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Group	Number	Treatment
I	5	Controls
II	6	600 r at 0 and at 35 days
III	6	600 r at 35 days only

The data on this small group of animals suggests that the anemia following a second irradiation may be more severe than that following the first. Although the red count did not fall lower after the second exposure than after the first, the control count was higher during the latter half of the experiment. In addition, Group III, irradiated at 35 days only, showed an anemia that was less severe than that which developed in the group irradiated twice. However, recovery did not appear to be more retarded after the second acute exposure, but in all instances was not complete at 35 days.

Comparison of erythrocyte and hemoglobin values of the irradiated groups showed that the recovery of the number of circulating erythrocytes was less rapid than the recovery of the hemoglobin values. This was especially apparent in Group II, but was seen only to a small extent in Group III, irradiated at 35 days only. This may be accounted for by the macrocytosis that was present at the last sampling (70 days). The mean erythrocyte diameters in the three groups were: Control - 6.85 μ; Group II (600 r at 0 and 35 days) - 7.25 μ; and Group III (600 r at 35 days only) - 8.17 μ.

40-E Progress Report of National Cancer Institute, by L. O. Jacobson and E. Lorenz. AECD - 2024-E, August 1, 1947, decl. May 26, 1948. 14 p.

Among the topics discussed are the following: effects of continuous X-radiation exposure of guinea pigs, rabbits, and mice; the mechanism of lung tumor induction following chronic X-irradiation; and the recovery of inbred guinea pigs from radiation induced anemia.

40-F Some Biological Phenomena Underlying Radiation Mortality, by G. Sacher and S. Tyler. AECD - 2024-F, August 1, 1947, decl. May 26, 1948. 33 p.

In recent years much progress has been made in the application of modern statistical methods to the evaluation and comparison of dosage-mortality curves based on small samples.

In this paper an extensive body of dosage-mortality data is analyzed. Records on some thousands of mice which received single doses of X-rays were available. These mice were irradiated in groups which were kept together throughout the period of observation. On each group of mice, information was obtained on (1) the X-ray dose given, (2) age, (3) the proportion of the group which died within twenty days after treatment, and (4) the mean survival time of the nonsurvivors. The analysis was directed toward exhibiting the relations between these variables as clearly and completely as possible. The aim was to determine whether mortality could be investigated as a physiological variable, i.e., whether degree of killing and mean time to death could reveal anything about the functional nature of the mechanisms of radiation injury and mortality.

There are several observations which can be made. First, the existence of successive orders of injury can be postulated. A given order of injury can appear only when injury of the previous order has reached a certain degree of severity. Second, if successive orders of injury exist, and if the appearance or non-

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appearance of a certain order of injury depends on external factors other than the administered dose, then multiple-valued relations between dose and mortality can exist. Present evidence indicates that the rate of mortality at a given time after irradiation is dependent on the instantaneous intensity of injury existing at that time, and further that rate of mortality is a rapidly increasing function of intensity of injury. The results so far reported are sufficient to justify the further investigation of the process of radiation injury and mortality, by methods which could be developed for use with data from properly designed experiments.

40-G Progress Report in Physiology, by H. M. Patt, M. N. Swift, and E. B. Tyree. AECD - 2024-G, August 1, 1947, decl. May 26, 1948. 9 p.

During the period May - July 1947 the work of the Physiology Group has consisted largely of (1) a continuing study of the influence of ambient temperature on X-ray toxicity in frogs; (2) studies of the effect of rutin on survival and on the hemorrhagic manifestations observed after X-irradiation; and (3) further experiments on the adrenal cortical response to X-irradiation. In addition, some consideration has been given to a proposed study of the vascular reactions in intact irradiated animals, using the method described by Nicoll and Webb for the wing membrane of the bat, Myotis lucifugus. In the bat wing, all types of vessels may be studied in their normal state since there is no need for anesthesia or surgical intervention.

40-H Some Further Notes on the Mice Treated with Plutonium before Weaning, by M. P. Finkel. AECD - 2024-H, August 1, 1947, decl. May 26, 1948. 11 p.

In August 1945 an experiment was begun to investigate the late effects of plutonium upon mice which were treated in utero. It was discovered that young mice obtained additional plutonium from the breast milk of their treated mothers. Therefore it was necessary to run another series of experiments which measured the Pu absorbed by suckling mice as well as the retention of the material by young animals. This information has made it possible to assign definite dose levels to the mice of the original experiment and to analyze the data which have been accumulating since the birth of these animals. Topics discussed are the dose levels, the relative contributions of plutonium from the placenta and the milk, the retention of plutonium by mice treated before weaning, and the effects of low levels of plutonium on growth.

40-I The Retention of P^{32} by Young Adult CF-1 Female Mice, by M. P. Finkel. AECD - 2024-I, August 1, 1947, decl. May 26, 1948. 2 p.

The retention of radiophosphorus by the animals comprising the single dose chronic experiment was studied one month after injection. The external counts of those animals which received 0.1 - 0.5 μc/g were too low to permit conversion to microcuries. The 10.0 - 0.5 μc/g groups gave adequate external counts. At these levels it was found that the absolute retention ranged from 1.2 to 1.7 per cent.

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40-J The Effect of X-Rays upon Antibodies (A Study of Hemolysin Titrations in Sensitized Irradiated Rabbits), by H. Fredell, et al. AECD - 2024-J, August 1, 1947, decl. May 26, 1948. 24 p.

Experiments were conducted using the rabbit as a test animal and measuring the antibody production in terms of hemolysins produced by sheep cell antigen. A group of sixteen rabbits was sub-divided into four groups of four animals each. The first group served as control; the second group was irradiated at the peak of the antibody response, approximately 10 days after antigen administration; the third group was irradiated on the day of antigen administration; and the fourth group was irradiated on the day of antigen administration and re-irradiated at the peak of antibody response. All irradiated animals received about 550 r at dosage rates of 16 to 17.7 r per minute, using 0.5 mm Cu and 1.0 mm Al filters. In addition, the animals in group four received a second dose of 550 r.

A single dose of 550 r total-body X-radiation depressed sheep cell antibody production in rabbits. When 550 r was administered at the time of sensitization, antibody production 10 days later was, for all practical purposes, completely inhibited within the period of study.

40-K Preliminary Report on Japanese Specimens, by A. M. Brues and W. Kisieleski. AECD - 2024-K, August 1, 1947, decl. May 26, 1948. 2 p.

Specimens of various materials including soil, mica plates, and glass have been collected from the Hiroshima and Nagasaki bombed areas and from the Nishiyama reservoir area which had been mildly contaminated by fission products arising from the atomic bomb explosion. They have been tested for induced radioactivity. Soil specimens collected in the reservoir area sixteen months after the detonation of the atomic bomb still showed significant radioactivity.

40-L Progress Report in Radiochemistry, by W. Neal, H. Ducoff, and R. Straube. AECD - 2024-L, August 1, 1947, decl. May 26, 1948. 3 p.

The work of the Radiochemistry Group has for some time centered about the production of As^{76}, the determination of the fate of As^{76} in normal and in tumor-bearing animals, the use of As^{76} as a therapeutic agent, and as a tool in the study of tumor metabolism and internal radiation.

40-M Arsenic - 76; Preparation by Pile Irradiation of Cacodylic Acid, by T. Kelly, W. Neal, and H. Ducoff. AECD - 2024-M, August 1, 1947, decl. May 26, 1948. 5 p.

Preliminary studies of the clinical use of As^{76} have indicated the need for radioactive arsenic of a higher specific activity than can be obtained by pile irradiation of As_2O_3. It is possible to obtain As^{76} of high specific activity by pile irradiation of cacodylic acid, and separation of As^{76} as the trichloride.

40-N The Effect of X-Irradiation on the Oxygen Consumption and Morphological Development of the Grasshopper Embryo (Melanoplus Differentialis), by T. N. Tahmisian and E. S. G. Barron. AECD - 2024-N, August 1, 1947, decl. May 26, 1948. 32 p.

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Grasshopper eggs are excellent material for the study of the effects of X-irradiation on growing tissues: They are easily handled; they can be raised in the laboratory the year around; large numbers of eggs can be obtained; the cells of the embryo are large; and extensive studies on developmental physiology are available. Irradiation of grasshopper eggs with X-rays from 10 r to 100 r in both the pre-diapause and the post-diapause state lowered the respiration immediately after irradiation. Respiration came back to normal 5 hours later in most cases. Formation of the embryo was inhibited with 50 r in eggs irradiated soon after being laid; 24 hours later, 200 r was necessary to produce such an inhibition; on the third day, the lethal dose increased to 500 r. The generalized or specialized embryonic cells were more susceptible to irradiation than the specialized serosa cells. The serosa cells were not destroyed after the first day with 1,000 r. In eggs irradiated with X-rays, there was no correlation between the oxygen consumption and embryonic development.

40-O Progress Report in Biophysics, by R. Withrow, E. Mika, M. Swanson, and D. Meneghetti. AECD - 2024-O, August 1, 1947, decl. May 26, 1948. 7 p.

A preliminary experiment was completed on the effect of Sr^{89-90} (as the chloride) on the growth of corn seedlings. The seedlings were grown in a nutrient solution containing 10 microcuries of active strontium per milliliter. This experiment was conducted to determine the most suitable procedures for growing and analyzing the plants. The most marked effects were the complete inhibition of lateral roots and an intervenal chlorosis of the leaves. Strontium activities in the shoot indicated that root damage was such that the absorptive capacity of the roots was greatly reduced.

40-P Lethal Effects of P^{32} on Paramecium Aurelia, by E. L. Powers, Jr., D. Shefner, M. J. Rickard, and R. Sato. AECD - 2024-P, August 1, 1947, decl. May 26, 1948. 4 p.

Further results on the response of P. aurelia to exposure to P^{32}, $Sr^{89,90}$ and Y^{90} have been obtained, and a partial summary statement of observations to date is presented. There is observed increasing death with increasing P^{32} radioactivity. Death following exposure to the Sr solution increases with increasing activity. Comparison of survival following phosphorus exposure to that following Strontium treatment at the same activity level, reveals that in all instances survival of the phosphorus-treated animals is the same or significantly lower than survival of strontium-treated animals. From these data it appears that the phosphorus-treated animals are injured to a greater extent than the strontium-treated animals.

41 The Retention of Uranium Dioxide in Rabbits, by C. LaBelle, C. Booth, and R. Barrett. AECD - 2028 (UR-24), April 19, 1948, decl. June 3, 1948. 32 p. (To be included in the NNES-MPTS, and for disposition as required for use in research, development, or manufacturing work). For sale by AEC.

An apparatus, fitted with a system of electronic controls, has been constructed in which a rabbit breathes dusty air in a face-piece. The valves are operated in such a way that the exhaled air is drawn off through

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a filter paper sampler at a regulated rate to maintain the air pressure within the face-piece essentially equal to that of the atmosphere. A duplicate line continuously samples the same volume as the atmosphere is being inhaled, permitting calculation of the quantity of dust retained by the rabbit.

When the retention in micrograms per minute per kilogram of body weight is plotted against dust concentration in micrograms per liter on a log-log plot, a straight line is obtained with a slope of 3/2 over the concentration range from 10 to 250 milligrams per cubic meter. No significant differences could be shown between the retention of dust particles one micron and those one-half micron in diameter. The quantity of dust retained was directly proportional to the volume of air breathed, and was independent of the rate of breathing. Individual animals show a two to three-fold variation from the mean probably as a result of anatomical variation in the respiratory tract.

42 Clinical Physiology of Dogs Injected with Plutonium, by E. Painter, et al. AECD - 2042 (CH-3858), June 1946, decl. June 3, 1948. 129 p. (To be included in the NNES - MPTS)

The clinical effects of plutonium (usually +6 citrate) upon dogs were examined after intravenous or intramuscular injection. The acute LD_{50} (16-day survival) for dogs is near 0.3 μg/g for intravenous dosage and between 0.35 and 0.68 μg/g for intramuscular dosage.

Circulating blood contained 25-50% of the intravenously injected dose with little decline for nearly 10 hours. The blood concentration reached a maximum at 3 hours, which was maintained until about 10 hours; after 10 hours both groups showed exponential decline in circulating plutonium. Essentially all of the Pu in blood was bound to the plasma proteins, most of it on the β-globulin.

Urinary excretion exceeded fecal excretion of Pu in the first 1-2 days. Thereafter fecal excretion was 2 to 6 times greater. Adults excreted an average of 9.6% of the injected dose in the first 3 days; individual total excretions ranged in this time from 2.7% to 22.0%, and there was no consistent difference according to route of injection. Thereafter excretion was slow and the average retention at 15 days was 85.7%, with decline to 70% in $2\frac{1}{2}$ to $3\frac{1}{2}$ years (extrapolated). Excretion in a group of 4 puppies was less, retentions at 15 days averaging 92.8%.

Organ analyses showed greatest concentrations in liver, spleen, bone and lymph nodes. Pu in bone was mostly associated with spicules, probably in the endosteum. There was extensive but real variation among different lumph nodes. Absorption from a muscle site was much greater than in rats.

Clinically, the plutonium-injected dogs closely resembled X-rayed dogs. The 3 dogs which died acutely (16 days) entered a terminal period of fever and elevated heart rate 3-4 days before death. They showed a rapid decline in all of the white cells of the blood to nearly zero at the time of death. The red cell count declined by 15-25%. Clotting time lengthened as did sedimentation rate. Plasma volume increased in each of these acutely treated dogs by one-sixth to one-fifth. During the second week after treatment food intake decreased and weight loss was rapid. In the terminal period plasma albumin was reduced and α_3 and α_4 globulin increased. At autopsy a typical radiation picture of hemorrhages and ulcers was found.

Two dogs died subacutely, one at 90 days and one at 234 days. The first of these (0.28 μg/g I.V. injected dose) showed a brief period of fever at 2 weeks and later showed fever and elevated heart rate for several days before death. Counts of granulocytes and lymphocytes were minimal at 10-15 days, the granulocytes showed slight recovery followed by a gradual decline, while the lymphocytes remained at one-

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tenth the control level throughout life. This dog showed a severe anemia. The number of red cells and the hemoglobin concentration gradually declined throughout the 90 days after injection to about one-third the control level. Plasma volume continuously increased. Blood creatinine and NPN declined at 2 months. Plasma albumin increased and α_3 and α_4 globulin increased 2 weeks, recovered at 3 weeks, and again altered before death. At autopsy there were fewer hemorrhages and ulcers than in acute radiation death but edema and anemia were marked.

The dog which died 234 days after treatment (0.40 μg/g I.M. injected dose) never had a period of fever. Its white cell count was minimal at 10 days but all elements except lymphocytes recovered nearly to control levels and there was no severe leucopenia terminally. The red count remained at 70% of the control level from about 3 to 10 days until within 4 days of death. Reticulocytes were less than 0.1% from 10 to 30 days and thereafter showed waves of abundance. Terminally, there was no increase in clotting time. Sedimentation rate was elevated during most of the post-injection period. Plasma volume increased to a maximum at 12 days but declined gradually thereafter. Weight loss was irregular but at death the body weight, aside from 1.4 liters of ascitic fluid, was 62.2% of the initial weight. There were very few hemorrhages. The liver was atrophic and the body severely emaciated.

Six dogs (2 adults and 4 puppies) at an injected dose level of 0.075 μg/g have shown no clinical abnormalities during more than 200 days except a reduction of approximately 50% in both granulocytes and lymphocytes. Neither anemia nor weight change has occurred. Chronic effects may yet appear in these animals.

43 Studies with Colloids Containing Radioisotopes of Yttrium, Zirconium, Columbium, and Lanthanum, Part II. The Controlled Selective Localization of Radioisotopes of Yttrium, Zirconium, and Columbium in the Bone Marrow, Liver, and Spleen, by E. L. Dobson, et al. AECD - 2055 (UCRL-92), April 21, 1948, decl. June 16, 1948. 16 p. (For publication in the Journal of Clinical Investigation). For sale by AEC.

Studies with several colloids containing radioisotopes of zirconium, columbium, and yttrium have shown that the biological distribution of such materials depends upon the nature of the colloidal particles. Colloids of zirconium of relatively large particle size show rapid disappearance from the blood stream (half-life = 30 seconds to 1 minute), and are deposited primarily in the liver and spleen. Colloids of intermediate particle size, both of zirconium and yttrium, disappear much more slowly from the blood stream (half-life = 30 minutes to 80 minutes) and are deposited primarily in the bone marrow and spleen, the liver acquiring only 1/3 the specific activity of marrow. Both types of colloids once deposited show no significant change in distribution pattern, at least over 2 to 4 week period, and only slow excretion from the body.

44 The Viability of Individuals Heterozygous for Recessive Lethals, by E. Novitski and C. Stern. AECD - 2062, (UR-28), April 29, 1948, decl. June 11, 1948. 6 p. (For publication in Science or Genetics). For sale by AEC.

Tests of daughters of females known to be heterozygous for a sex-linked lethal show that the viability of individuals heterozygous for a lethal is not equivalent to that of individuals free from a lethal. The per cent of lethal-bearing daughters should, within statistical limits, fall equally about 50 per cent.

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Thirty-three lethals showed a marked inequality of distribution with 5 lethals above and 23 below the expected midclass. The range of values is also unequal, the lowest being 42.1 per cent of lethal-bearing daughters and the highest 53.7 per cent. It is pointed out that decreased viability of lethal heterozygotes in populations where the frequency of the lethal gene is very low, might be more important than the loss of rarely occurring homozygotes.

45 Action of Uranium Nitrate on Experimental Rat Sarcoma (Galliera Strain), by L. Ghetti. Tumori 28, p. 387-401, 1942.

No beneficial effect could be demonstrated. Uranium nitrate is toxic, especially to kidney and liver.

46 The Distribution and Excretion of Injected Uranium, by W. F. Neuman, R. W. Fleming, Alexander L. Dounce, A. B. Carlson, J. O'Leary, and B. Mulryan. Journal of Biological Chemistry 173, p. 737-748, April 1948.

Experiments on the distribution and excretion of injected uranium were conducted on rats, rabbits, and cats. Roughly two-thirds of the dose was excreted rapidly via the urine. As much as one-fifth was found in the skeleton from which it was mobilized slowly. The kidney initially fixed as much as one-fifth of the dose, but the concentration fell rapidly to a very low value in 40 days. All other soft tissues (including blood) contained negligible quantities. Alkali administration reduced the amount deposited in kidney, increasing proportionately the quantity found in urine. Ammonium chloride feeding exerted an effect opposed to that of alkali administration.

47 Experiments with Radioactive Phosphorus in Rats, by H. J. Born. Naturwissenschaften 28, p. 476, 1940.

Rats were injected in the tail vein with aqueous Na_3PO_4 containing P^{32}, and were killed and dissected 72 hours later. The ratio of active to inactive P in different parts of the skeleton and various organs was then determined. It is lowest in the teeth and highest in the sex organs.

48 Industrial Medicine, by D. Hunter, Schweizerische Medizinische Wochenschrift 76, p. 917, September, 1946.

Substances handled in industry may attack the respiratory tract and produce pneumoconioses, inflammatory and allergic conditions and possible carcinoma. Cadmium, vanadium and beryllium are important constituents of certain alloys. The first two metals, if inhaled in the form of oxides in dust or fumes produce inflammation of the upper and lower respiratory tract, which may be acute or chronic. Acute bronchopneumonia, at times fatal, may follow poisoning with cadmium oxide, and chronic bronchitis is more often seen in vanadium workers.

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Beryllium fumes are of statistically greater importance because of the use of this metal in the aircraft industry. The upper respiratory tract is profoundly irritated, and the inflammation may extend into the lung producing bronchiolitis and chemical pneumonia. Autopsy of some fatal cases showed a picture of atypical pneumonia with hemorrhage and edema. The predominating cell infiltration consisted of plasma cells. (Some beryllium cases have an X-ray appearance very much like disseminated nodular sarcoidosis, the nodules being rather small. There is also some histological similarity). Bagassosis is characterized by acute febrile illnesses in which cough and dyspnea are outstanding. The X-ray film shows scattered miliary densities. The picture is one of acute diffuse bronchiolitis. The majority of cases clear within weeks or months, but some have resulted in chronic fibrosis, bronchiolitis and bronchiectasis. One such autopsy is on record. The etiological agent in this disease is not known. Bagasse contains 1 to 2 per cent of amorphous silica, and 0.1 per cent of quartz, but the majority of the quartz particles are larger than those considered necessary for production of silicosis. It is believed that fungi may play an important part in breaking down bagasse fiber into a fine vegetable dust, and may render this toxic. The disease resembles byssinosis. In the past it was felt that the high incidence of carcinoma in the Schneeberg miners was due to the radioactivity of the hard rock. Recently it has been questioned if the high arsenic content of the rock, 0.45 per cent, may not be the cause of development of cancer.

49 Significant Aspect of Exposure to Beryllium Compounds in Industry, by Charles R. Williams. Occupational Medicine 4, 104-110, 1947.

A general review of reported occupational disease due to exposure to Be compounds.

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50 The Mass Spectrometer Analysis of Volatile Products of Metabolism, by A. J. Dempster, M. G. Inghram, and D. C. Hess, Jr. AECD - 2027 (ANL-AJD-241), January 15, 1948, decl. May 21, 1948. 3 p. (For oral presentation at the Argonne National Laboratory Conference held May 21, 1948, and for publication in a biological journal). For sale by AEC.

This paper gives a description of a simple technique that may be used to observe the ions of organic molecules exhaled in the breath of a human being. This application makes use of the great sensitiveness of the mass spectrometer for analysis, rather than its power to separate ions with different "labelled" stable isotopes. While this latter use is no doubt of great interest for biologists at the present time, the possibilities for biological studies in the first simple straightforward application of this instrument to gas analysis should not be overlooked.

51 Isolation of Milligram Amounts of Element 43 from Uranium Fission, by G. W. Parker. AECD - 2043 (CNL-1), January 9, 1948, decl. June 4, 1948. 31 p. (For oral presentation before a meeting of the American Chemical Society held in Syracuse, N. Y., June 28-30, 1948, and for publication in a technical journal). For sale by AEC.

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An abstract of this document has previously been issued as AECD - 1995 and listed in Abstracts of Declassified Documents.

52 The Direct Spectrochemical Analysis of Solutions Using Spark Excitation and the Porous Cup Electrode, by C. Feldman. AECD - 2035, n.d., decl. June 4, 1948. 17 p. (For oral presentation before a meeting of the American Chemical Society held in Norris, Tennessee, June 5, 1948, and for presentation before a meeting of the A. C. S. to be held in Washington, D. C., August 30-September 2, 1948). For sale by AEC.

An abstract of this document has been issued as MDDC - 1752 and listed in Abstracts of Declassified Documents.

53 Use of Ion Exchangers in Analytical Chemistry, by R. H. Lafferty, Jr. AECD - 2061, n.d., decl. June 1, 1948. 1 p. (For oral presentation at a meeting of the East Tennessee Section of the American Chemical Society held in Oak Ridge, Tennessee, June 5, 1948, and for subsequent publication in Analytical Chemistry)

This document is an abstract and the entire text is presented here.

Although there has been a wide increase in the industrial applications of ion exchangers since synthetic exchangers were discovered by Adams and Holmes in 1935, the uses of these materials in analytical chemistry to date have been rather limited. This paper discusses the analytical applications of ion exchange techniques which have appeared outside of the Atomic Energy Commission publications. The utilization of ion exchangers falls into the following general classes both for analytical chemistry as well as industrial work: (1) Removal of impurities: In analytical chemistry this frequently involves a complete separation of anions and cations followed by a determination of the anions as acids. (2) Concentration of trace amounts of materials: Although this application is the most obvious field of interest to the analytical chemist, it has received the least attention to date. (3) Separation of materials: This use has been widely exploited in the field of biochemistry, particularly in the analysis of amino acids. (4) Miscellaneous applications: Ion exchangers are used frequently in the studies of complex ions to determine the nature of the ions existing in the complex.

54 Application of the Mass Spectrometer to Fission Products, by R. B. Shields. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 101-107, 1947.

This is a review article describing the 90° mass spectrometer and its application to the study of fission products. The use of this instrument in identifying long-lived isotopes produced in fission processes, assigning mass numbers to fission chains, determining half-lives and relative abundance of isotopes produced in fission, and measuring neutron capture cross sections is described.

CHEMISTRY, ANALYTICAL

55 Chromatographic Adsorption Analysis Under Increased Pressure, by E. M. Titov. Zavodskaya Laboratoriya 13, p. 1359-1364, November 1947. (In Russian).

Describes new technique and apparatus utilizing a pressure of 250-300 mm. above atmospheric instead of the usual vacuum. 14 references.

56 Ion-Exchange Separation of the Alkali Metals. Journal of the American Chemical Society 70, p. 1986, May 1948.

Preliminary results are reported on the separation of alkali-metal ions by an ion-exchange procedure, using the identical column and resin bed used by Mayer and Tompkins in their 61-Eu separation (Journal of the American Chemical Society 69, p. 2866, 1947).

A neutron-activated mixture of Na, K, Rb and Cs, in the form of their chlorides, was dissolved in water and absorbed on the hydrogen-form column. Elution was then begun with 0.15 N HCl at a flow rate slow enough to permit an approach to equilibrium conditions. The effluent from the column was collected in a number of fractions, each of which was radiometrically analyzed for Na^{24}, K^{42}, Rb^{86}, and Cs^{134}.

57 Remarks Concerning the Separation of Vanadium from Boron, by Georges Weiss and Pierre Blum. Bulletin de la Société Chimique de France, p. 1077-1079, December 1947. (In French).

Explains a method of separation based on the insolubility of barium vanadate in the presence of an excess of barite, and the solubility of barium borate under the same conditions. Application to a mixture of vanadium boride and oxides is described.

58 X-Ray Diffraction Analysis of Crystalline Dusts, by Harold P. Klug, Leroy Alexander, and Elizabeth Kummer. Journal of Industrial Hygiene and Toxicology 30, p. 166-171, 1948.

Dusts are commonly rather complex mixtures of chemical compounds, and their accurate analysis is, therefore, a correspondingly difficult problem. One of the most recent advances in dust analysis is the application of the Geiger-counter X-ray spectrometer to the problem. The Geiger-counter spectrometer offers advantages in the determination of the intensities of the diffraction lines, and better resolution in cases of partial line superposition. It also offers a possibility of avoiding the use of an internal standard in some cases. Details of the adaptation of the internal standard technique of Clark and Reynolds to the recording Geiger-counter spectrometer are given. Above 10 per cent quartz the results are usually good to within ± 5 per cent of the absolute amount of quartz present. The problem of line superposition is also discussed.

CHEMISTRY, GENERAL

59 **The Rearrangement of Chalkene Epoxide, by C. J. Collins. AECD - 2033, n.d., decl. June 3, 1948. 1 p. (For oral presentation before a meeting of the American Chemical Society held in Norris, Tennessee, June 5, 1948)**

This paper is an abstract and is presented here in full.

Acetophenone labelled in the carbonyl group has been allowed to react with benzaldehyde to yield carbonyl labelled benzalacetophenone. The latter compound upon treatment with hydrogen peroxide yields the epoxide of carbonyl labelled benzalacetophenone. Upon treatment with alkali, this epoxide undergoes rearrangement to yield alpha hydroxy benzyl-phenyl acetic acid. Decarboxylation of this acid yielded carbon dioxide and desoxybenzoin. The carbon dioxide so obtained possessed no carbon-14. The desoxybenzoin on the other hand possessed 100% of the original carbon 14 activity. It is planned to prepare the oxime of the latter compound, and subject it to a Beckmann rearrangement to yield phenylacetanilide. Hydrolysis to phenylacetic acid and oxidation to benzoic acid and carbon dioxide followed by radioactive assay of these two compounds should place the position of the carbon-14 in the desoxybenzoin.

60 **Studies with Colloids Containing Radioisotopes of Yttrium, Zirconium, Columbium, and Lanthanum, Part I; The Chemical Principles and Methods Involved in Preparation of Colloids of Yttrium, Zirconium, Columbium, and Lanthanum, by J. W. Gofman. AECD - 2057 (UCRL-91), April 21, 1948, decl. June 16, 1948. 13 p. (For publication in the Journal of Clinical Investigation). For sale by AEC.**

Colloids of yttrium, zirconium, columbium, and lanthanum have been prepared incorporating radioisotopes of these elements, for the purpose of selectively localizing radiation in certain tissues and organs, as the liver, spleen, and bone marrow. The methods of preparing colloids of different stabilities and particle sizes are described together with the chemical basis for such preparations.

61 **Preparation of Radioactive Carbon-Labeled Sugars by Photosynthesis, by E. W. Putman, W. Z. Hassid, G. Krotkov, and H. A. Barker. Journal of Biological Chemistry 173, p. 785-795, April 1948.**

Methods are described for the isolation of radioactive (C^{14}) starch, glucose, fructose, and sucrose from plants exposed to an atmosphere of radioactive carbon dioxide in the presence of light.

62 **Preparation of Radioactive Tracers, by L. Siminovitch. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 120-126, 1947.**

The methods of preparation of C^{14}, P^{32}, S^{35} and I^{131} are given. The possibilities of using the Canadian pile at Chalk River for small and large scale production of tracers are assessed. High specific activities (ratio of disintegration per unit time to weight of inactive isotopes present) are necessary for many chemical and biological tracer experiments; therefore, the separation of radioactive atoms with as small amount of inactive isotope as possible is an important problem of tracer production.

CHEMISTRY, GENERAL

63 Preparation of Stable Tracers, by H. G. Thode. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 127-133, 1947.

The various methods of preparing N^{15}, C^{13}, O^{18}, S^{34}, and S^{36} are reviewed, and the choice of isotope, the quantities available, and the cost are discussed. The chemical exchange method can be used successfully for separating the isotopes of H, C, N, O, and S. The rate of production by this method is higher than that of other methods, and enrichments can be obtained suitable for most isotope exchange and tracer work.

64 Production of Radioactive Carbon Monoxide and Phosgene from Barium Carbonate, by J. L. Huston and T. H. Norris. Journal of the American Chemical Society 70, p. 1968, May 1948.

The method developed involved the reduction of $C^{14}O_2$ (obtained from $BaC^{14}O_3$) to $C^{14}O$ by hot zinc. Phosgene was the prepared photochemically by the reaction of $C^{14}O$ with chlorine.

65 Structure of Complex Compounds, Part I, by Ya. K. Syrkin and M. E. Dyatkina. Zhurnal Obshchei Khimii 16, p. 342-378, 1946.

Complex-forming atoms are distinguished by a small differences between the energy levels of the d, s, and p electrons, which make valencies of up to nine possible. Structural formulae based on this assumption are advanced for ionic and non-ionic complexes of the type $[MR_x]$, where M is a metal, and R = CO, CN, NO, NO_2, or NH_3.

66 Synthesis of Organic Compounds Containing C^{12} and C^{14}, by L. P. Bouthillier. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 167-173, 1947.

Synthetic procedures for the selective labeling of carbon atoms in organic molecules are reviewed. Radioactive C^{14} is shown to be one of the more important tracer elements used in organic and biological chemistry. A flow sheet for the preparation of several organic compounds is given.

67 Target for Irradiation of Powders by Deuterons; Preparation of Radio-Iodine and Radio-Phosphorus, by P. Sue and A. Occhi. Bulletin de la Société Chimique de France, No. 3-4, March-April 1948. (In French)

Irradiation of a substance in a cyclotron by a stream of deuterons often presents certain difficulties. Metals that can be laminated and have high melting points (Cu, Fe) are easily irradiated by placing a sheet of the metal a few tenths of a millimeter thick on the cooled window where the deuterons strike. A method has been developed for the irradiation of metals that connot be laminated. The interior target consists of a wire gauge in which the powder to be irradiated is compressed. Cooling is efficient, and manipulations are simplified.

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CHEMISTRY, GENERAL

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The chemical preparations of radio-iodine and radio-phosphorus are described. For intensities up to 8 microamperes the metallic gauze gives good results, even for weakly conducting substances such as phosphorus. This method is particularly adaptable to insulating substances such as silica, and to metals that are not easily rolled, such as tungsten.

CONTROL OF ATOMIC ENERGY

68 Atomic Energy, Its International Implication, by Chatham House Study Group. New York, Royal Institute of International Affairs, 1948, 128 p.

The Chathan House Study Group was appointed to consider the problem of atomic energy and its effects on international relations. This report reviews the scientific and technical background, the problem of raw materials, and wartime and peacetime applications of atomic energy. It considers proposals which have been made for an international control system with the view of devising an effective plan which would be acceptable to the United Nations as a whole.

Periodicals listed in this abstract journal are on file in the Library of Congress. The Union List of Serials may be consulted for the availability of these publications in other libraries. Members of the American Chemical Society may purchase microfilms or photoprints of some of the articles listed through this Society.

COSMIC RADIATION

69 Azimuthal Effect of Cosmic Rays at Bombay (Magnetic Latitude 9.5°N), by P. S. Gill and G. H. Vaze. Physical Review 73, p. 1395-1396, June 1, 1948.

A study of the azimuthal variation of cosmic-ray intensity was made at Bombay (λ = 9.5°N) for a fixed zenith angle at 60°. Since for positive primary particles the penumbra bands are prominent in the N-W quadrant, telescopes were directed toward this quadrant and the one opposite to it. Measurements were made for approximately forty hours at intervals of 10 degrees. The test shows that the observations are not yet satisfactorily uniform. The primary spectrum for energy range from 350 to 640 ms can be represented by K/E^C with C = 2.45.

70 Cosmic Rays, by L. Jánossy. London, Oxford University Press, 1948. 424 p.

71 The Directional Intensity of Cosmic Rays at Several Altitudes, by Matthew Sands. Physical Review 73, p. 1338-1340, June 1, 1948.

The vertical intensity and the intensity at inclined directions of the ionizing cosmic rays which penetrate 5 $g-cm^{-2}$ of brass have been measured with a counter telescope at several altitudes between sea level and 10,700 meters.

72 Highly Ionizing Particles in the Cosmic Radiation, by V. Veksler, N. Dobrotin, and V. Khovles. Zhurnal Eksperimental'noĭ i Teoreticheskoĭ Fiziki 16, No. 7, August 1946. 3 p. (In Russian)

Results of measurements of the number of highly ionizing particles in cosmic rays at an altitude of 3,860 meters are reported. They show that the number of particles, the ionization of which exceeds 3-4 times the ionization of fast mesotrons, is less than 0.5% of the number of the penetrating particles of cosmic rays.

73 The Latitude Dependence of Neutron Densities in the Atmosphere as a Function of Altitude, by J. A. Simpson, Jr. Physical Review 73, p. 1389-1391, June 1, 1948.

In order to study nuclear evaporation processes and the origin of neutrons in the atmosphere, a series of experiments was performed in B-29 aircraft which included the measurement of neutron densities for several altitudes at 0°, 19°N, 40°N, and 53°N magnetic latitude. The total vertical intensity of charged particles traversing 5 g/cm^2 and the vertical intensity of mesons traversing 20 cm of lead were also measured at the same time. Experimental arrangements are briefly described and results are tabulated.

COSMIC RADIATION

74 Measurements of the East-West Asymmetry of Cosmic-Rays at Lahore, India (22°N), by Om Parkash Sharma and H. R. Sarna. Indian Journal of Physics 22, p. 19-26, January 1948.

A triple coincidence counter telescope has been employed for the present study of east-west asymmetry at Lahore (22°N). Each Geiger-Muller tube consisted of a 0.194 mm diameter nickel wire anode and an oxidized cylindrical copper cathode (.25 mm thick) 2.5 cm in diameter and 35 cm in length, sealed in a pyrex glass tube. The counters were filled with ethyl alcohol (1.5 cm) and argon (9.5 cm) mixture to a total pressure of 11 cm of mercury. The telescope was mounted on a light wooden frame capable of rotation about the horizontal as well as the vertical axis, the angles being read accurate to one-fourth of a degree by pointers moving on graduated circular scales.

The asymmetry measurements were made for a number of zenith angles. The maximum of asymmetry occurs at 30° with respect to the zenith. The results have been compared with those of other observers and it is suggested that the small apparent divergences might be due to differences in the angular cones subtended by the telescopes used by different observers.

75 On the Analysis of Extensive Cosmic-Ray Shower Data, by H. W. Lewis. Physical Review 73, p. 1341-1345, June 1, 1948.

Formulae are derived, on the basis of the primary electron hypothesis, which describe the behavior of counters exposed to the large air showers. In particular, expressions for the variation of counting rate with area of the counters, number of counters, and altitude are given, and seem to agree fairly well with experiment, except for the latter at very high altitudes.

76 On the Differential Energy Spectrum of Mesons, by M. H. Shamos and M. G. Levy. Physical Review 73, p. 1396-1397, June 1, 1948.

Three points have been obtained in the important low energy region (kinetic energy $< 10^9$ ev) of the differential spectrum at sea level by means of a meson detector based upon the instability of mesons. The points have been located at 210 $\pm$ 30, 495 $\pm$ 30, and 890 $\pm$ 30 Mev.

77 Radiation Research, by W. G. Klemperer. (Fiat Evaluation Report 196). Innsbruck, Austria, University of Innsbruck, n.d. 1 p. (OTS PB L 88354)

Information on Austrian work in the field of cosmic rays and acoustics.

78 Search for Electrons in the Primary Cosmic Radiation, by Robert I. Hulsizer and Bruno Rossi. Physical Review 73, p. 1402-1403, June 1, 1948.

Preliminary results have been obtained from an experiment designed to determine whether or not high energy electrons or photons are present in the primary cosmic radiation.

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COSMIC RADIATION

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The authors conclude that the ratio of electrons or photons of energies greater than 4.5 Bev to the total number of primary cosmic rays is less than 1 per cent. This also represents an upper limit fo: the total number of electrons in the primary radiation, since the latitude effect showed that no singly charged particles with momentum larger than 4.5 Bev/c are present.

The authors emphasize that it is not necessary to postulate the existence of any electrons or photons in the primary radiation since cascade showers have been observed to be produced in lead by penetrating particles believed to be high energy protons.

79 Specific Ionization of Cosmic Ray Mesotrons, by S. N. Ghoshal. Proceedings of the National Institute of Sciences of India 11, p. 353-357, 1945.

Energy losses of cosmic ray mesotrons are determined from absorption measurement in lead. They are compared with theoretical energy losses calculated from the ionization formula of Block (Annalen der Physik 16, p. 285, 1933). The experimental curve is similar to the theoretical curve in that an initial rapid fall is followed by a slow rise in the value of dE/dT. The minimum for the experimental curve appears in the energy region 7×10^8 ev; that of the theoretical curve between 2×10^8 and 3×10^8 ev. The energy loss value at the minimum is 0.6×10^6 ev; the theoretical value is 1.1×10^6 ev. The maximum energy transferred to the electrons appears to be less than that predicted by theory.

DEUTERIUM

80 The Ultraviolet Spectra and Ionization Potentials of the Hydrides and Deuterides of Sulfur, Selenium, and Tellurium, by W. C. Price. Journal of Chemical Physics 16, p. 551-552, May 1948.

The absorption spectra of the hydrides and deuterides of sulfur, selenium, and tellurium have been obtained in the vacuum ultraviolet. All these substances have regions of weak continuous absorption between 3000 and 2000 A. Below 2000 A the spectra consist of a large number of relatively discrete bands. The bands of hydrogen sulfide start around 1590 A and converge to an ionization limit corresponding to 10.5 volts, those of hydrogen selenide start at 1693 A and converge to 9.7 volts: while those of hydrogen telluride start at 1920 A and converge to 9.1 volts. The closeness of these ionization potentials to the corresponding values for the atoms (viz. S, 10.3 volts; Se, 9.5 volts; Te, not known accurately but close to 9.0 volts) is clearly significant. The ionization potentials of the deuterides are not appreciably different from those of the corresponding hydrides.

FLUOROCARBONS

81 Properties of "Fluorothene", by W. H. Reysen and P. R. Vanstrum. AECD - 2032, December 26, 1947, decl. June 3, 1948. 8 p. (Informal disposition and for possible publication). For sale by AEC.

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FLUOROCARBONS

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With a view toward first obtaining the most useful information, emphasis has been placed on the determination of the properties of "Normal Fluorothene" at standard atmospheric conditions. "Normal Fluorothene" is defined as material having a molecular weight molding conditions, and quenching conditions similar to the material in most general use at the present time. All tests performed to date have been made using "Normal Fluorothene" samples. Considerable information has been accumulated on the chemical, physical, electrical, and mechanical properties of this material. It is the purpose of this memorandum to make these data available in tabulated form.

HEALTH PROTECTION

82 Current and Future Environmental Control Problems Attendant on the Use of Radioactive Energy, by L. F. Curtiss. American Industrial Hygiene Association Quarterly 8, p. 14-18, 1948.

Radiation protection measures, remote control and supervision of nuclear processes involving emission of radiation, and medical aspects of the radiation problem connected with nuclear transformations are discussed. It is anticipated that radiations encountered in the future will be of higher intensity than at present.

83 Gamma-Ray Protection in Radium Therapy, by C. W. Wilson and J. R. Greening. British Journal of Radiology 21, p. 211-220, May 1948.

It is suggested that if the γ-ray dosage received by radium therapists during their radium work could be assessed (even if only roughly), more specific opinion might be formed as to what levels of exposure have proved to be safe.

Calculations and measurements of local dosage and integral dose received by radium mould technicians and radium therapists are made in order to make each assessment. On the basis of these results the implications of the various proposed standards of protection are examined and set out in terms of actual working conditions. For this purpose protection is considered in the categories in which it seems the subject should be divided, viz., local exposure of the hands, local exposure of the gene material and integral dose throughout the whole body.

In relation to medical work it is concluded (1) that many busy radium personnel may receive local exposure to the hands in excess of that now recommended in the U. S. A. as a safe amount (1 r-per day), (2) that if circumstances dictate it should be practicable, by the use of suitable screenage, to reduce the local dose received by the gentials of mould technicians and therapists to the low figure recently suggested by Sievert (0.01 r per day), and (3) that this low figure may be impossible of realisation for the integral dose received by personnel handling radium.

It is suggested that in respect of integral dose, past experience indicates that a figure of 0.1 r per day may be safe. It is, however, desirable to achieve 0.01 r per day, particularly for personnel continually receiving radiation at a low but approximately uniform dose-rate over the whole body—this is because injury to the gene material is the foremost consideration.

Suggestions are made for the furture collection of data which will assist in placing protection standards on a surer foundation.

HEALTH PROTECTION

84 Health Aspects of Radioactive Work, by D. F. Brown. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 205-211, 1947.

The biological effects of radiation, and health hazards connected with radiological work are discussed. Personnel monitoring and radiation protective devices are considered.

85 Industrial Hygienists Discuss Radiation Hazards, A Staff Report. Chemical and Engineering News 26, p. 1074-1076, April 12, 1948.

Among the papers presented at the ninth annual meeting of the American Industrial Hygiene Association in Boston in March were the following: "Protection Against Radiation Hazards and Maximum Allowable Exposure Values" - by K. Z. Morgan of the Oak Ridge National Laboratories; "Radiation Measurements in Health Physics" by J. W . Healy of the Hanford Engineer Works.

86 Practical Precautions with Neutron Sources, by K. J. McCallum. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 214-216, 1947.

The practical precautions to be observed in order to prevent overexposure to neutrons and gamma radiation from radon sources is outlined. In general, any arrangement which gives adequate protection against overexposure to gamma radiation will also be sufficient for protection against neutrons.

INSTRUMENTS

87 Recording Type Automatic Geiger Tube Calibrator, by G. J. Crits and G. C. Newlin. AECD - 2025 (LADC - 524), April 27, 1948. decl. June 3, 1948. 15 p. (Disposition as required for use in research, development, or manufacturing work and for publication in a technical journal. This includes the declassification of the recording type automatic Geiger tube calibrator). For sale by AEC.

An automatic Geiger-Muller tube calibrator has been designed which makes it possible to relieve the investigator of the tedious recording and calibrating job. The recording type AGTC (Automatic Geiger Tube Calibrator) will plot the calibration of a tube in a series of 10 to 15 voltage steps. The length of time is predetermined for each step between 0 and 60 seconds by the employment of an adjustable timer. The voltage differences on the Geiger tube are obtained by setting the scaler voltage to a fixed high value (lead to center electrode of Geiger tube) and applying to the shell of the Geiger tube a variable (in 20 volt steps) plus voltage from a voltage regulated power supply. Each step represents a different successive voltage as indicated by the difference of scaler and controller voltage. The height of the steps indicate the counting rate which will be essentially constant on the plateau. A block diagram and a schematic diagram of the instrument are given.

INSTRUMENTS

88 Insulation Flashover Tests in Vacuum and Pressure, by J. L. McKibben and R. K. Beauchamp. AECD - 2039 (LADC - 523), n.d., decl. June 3, 1948. 28 p. (For oral presentation before a conference on Electrostatic and High-Energy Accelerators at M. I. T., June 7-10, 1948, and for publication in the Review of Scientific Instruments) . For sale by AEC.

An electrostatic test generator has been built and used for determining insulation flashover voltages. It is contained in a pressure vessel 30" OD which will hold 35 atmospheres. A special feature of this generator is a gas tight separation column which allows the charging belt to be operated at a lower pressure or even with a different gas than that around the high potential electrode. With SF_6 gas insulation, voltages up to 4 million volts have been obtained across an active belt section and insulation column 18 inches long. Curves of flashover voltage versus pressure are given for air, nitrogen, CCl_2F_2, and SF_6. Tests on insulation pressure in 21 atmospheres of air have shown that properly mounted, glass-bonded mica insulators will sustain more than one half the voltage than the gap itself will sustain. Vacuum insulation is more difficult than pressure insulation because the electrodes will not sustain as high a gradient unless the electrodes are carefully prepared and closely spaced. In vacuum, properly prepared glass or glass bonded mica insulation does not appear to reduce flashover voltage seriously when placed in gaps of about 1 cm or less. The best electrode materials appear to be aluminum, steel, nickel, and some alloys of these metals. This report is based upon nearly two years test work with this generator.

89 Excitation Time of Silver Activated Zinc Sulphide on Electron Bombardment, by J. F. Mullaney, F. Reines, and H. G. Weiss. AECD - 2041 (LADC - 519), March 25, 1948, decl. June 9, 1948. 2 p. (For publication in Physical Review). For sale by AEC.

An experiment designed to study the promptness with which a phosphor excited by electron impact emits visible light was performed. In the specific case studied, the excitation of a Dumont 5JP11 phosphor, i.e. Ag activated ZnS, by 4 Kev electrons, the rise time of visible radiation was found to be $< 10^{-8}$ seconds, a limit set by the amplifier system employed.

90 Positive Ion Gun for the Notre Dame Van de Graaff-Herb Generator, by M. L. Wiedenbeck. AECD - 2045 (ANL-HDY-463), 1945, decl. May 21, 1948. 5 p. (Informal disposition and to be included in the NNES(MPTS). This also includes declassification of the positive ion gun.)

A particular source for positive ions is not equally applicable to all accelerating instruments. Fundamentally such a source is a chamber in which a low voltage arc sustained between electrodes produces ions; some of the ions are pulled out of the chamber through a small channel into the accelerating tube.

Many satisfactory sources have been built. However, the requirements of the Notre Dame Van de Graaff-Herb generator are more or less special. First, it is not possible to cool the ion source without great difficulty. Secondly, the distance from the ion source to the vacuum pumps is large ($\sim$40 feet), and thirdly, the accelerating tubes contain 96 electrodes which act as baffles.

These problems were solved by the use of an arrangement employing a small but concentrated arc current and a very narrow canal to admit the ions to the accelerating tube.

INSTRUMENTS

91 **Pulse Characteristics of Anthracene Scintillation Counters, by L. F. Wouters. AECD - 2048 (UCRL-106), May 12, 1948, decl. June 3, 1948. 2 p. (For publication as a Letter to the Editor of Physical Review)**

The entire document is reproduced here.

Results obtained by various investigators using naphthalene and anthracene as scintillation counters have been duplicated. In one arrangement, the fluorescence due to beta particles induced by gamma radiation from a radium source in a piece of anthracene 1" x 1" x 1/4" was detected as pulses of up to 1/2 volt height at the output of a 1P21 photomultiplier detector operated at room temperature with 70 volts per stage. Under these conditions, the pulse output due to the direct photoelectric effect by the gamma radiation on the photomultiplier surface was indistinguishable from thermal noise.

For photomultiplier stage voltages up to 120 volts, the signal-to-noise ratio remained substantially constant at about 5:1 for the largest pulses in this particular arrangement. It was further determined that this ratio is insensitive to the voltages applied to stages beyond the first two. Hence, by applying higher voltages to the seven last stages (180 to 200 volts) it is possible to raise the total gain sufficiently to dispense with conventional vacuum tube pulse amplifiers. The standard commercially available 1P21 9-stage photomultiplier mounted directly at the deflecting plate terminals of a 5JP1 oscilloscope tube shows individual pulses (for the same geometry and source as described above) of up to 20 volts in height. Since the charge transferred through the last few photomultiplier stages is then quite large, it is necessary to bypass those stages at the socket with small mica capacitors. The total voltage across base pins 10 and 11 is in the neighborhood of 1800 volts, so that precautions must be taken against breakdown. A slot was cut halfway through the base and socket between these pins, and a small sheet of 1/32" polystyrene was inserted snugly into that slot. The tube base was filled with ceresin wax after cutting off the locating key, and the socket and circuit elements were likewise liberally coated with ceresin wax.

The arrangement described permits direct determination of the duration of the counting event by variation of the decrement of the output circuit. Rough measurements confirmed previous visual oscilloscope observations of an event duration of perhaps 0.1 microsecond. This is a factor of 100 longer than the response time of a photomultiplier, so that this appears to be the ultimate limit of resolution of the anthracene as a detecting substance. It is a reasonable assumption that the other benzene chain compounds would not exhibit radically different behavior in this regard.

92 **An Investigation of the Input Grid Current of the Type 959 Acorn Tube Used as an Electrometer Tube, by C. S. Wu and L. J. Rainwater. AECD - 2049, December 1, 1944, decl. June 8, 1948. 14 p. (Informal disposition. This also includes declassification of the 959 acorn tube used as an electrometer tube). For sale by AEC.**

Investigation of 14 tubes selected at random from a group of type 959 "acorn" pentodes showed input grid currents between 0.5×10^{-14} and 2×10^{-14} amperes when operated as electrometer tubes under special conditions. A Victoreen electrometer tube tested under similar conditions was found to have a grid current of 0.6×10^{-14} amperes. Both types of tubes showed flat grid current vs grid voltage curves over the entire operating region (input grid resistance $>10^{15}$ ohms). To obtain the full advantage of these tubes, extremely low humidity must be maintained at the tube and in the vicinity of the input circuit. When exposed to room humidity the grid currents were larger than those stated above

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regardless of the special "moisture-proof" treatments given to the insulation surfaces. In addition to increasing the total grid current the humidity also introduced a definite slope in the grid current vs grid voltage curves (input grid resistance $\leq 2 \times 10^{14}$ ohms). It was concluded that the special treatment of the surfaces thus far used cannot be entirely depended upon as a substitute for low humidity to prevent leakage currents.

93 Battery Operated Inverse Feedback Electrometer Circuits and Gamma Radiation Meter, by C. S. Wu and L. J. Rainwater. AECD - 2050, n.d., decl. June 8, 1948. 30 p. (Informal disposition. This also includes declassification of the battery operated inverse feedback electrometer circuits and gamma radiation meter). For sale by AEC.

For the detection of low intensities of alpha, beta, or gamma radiation a portable unit consisting of an ionization chamber and an electrometer circuit is designed to achieve the required sensitivity and stability. In order to read the output on a microammeter, it is ofter desirable to use a multistage amplifier. The gain of such an amplifier depends directly on the characteristics of the vacuum tubes used and therefore varies with the potentials on the electrodes. The gain of such an amplifier must therefore be calibrated from time to time and is apt to be somewhat non-linear over the range of operation unless special precautions are taken. Fortunately, many of the difficulties of multistage D.C. amplifiers can be reduced or essentially eliminated by the use of inverse feedback principle. The battery operated inverse feedback circuits developed proved to be sensitive, stable, and compact. The portable gamma-radiation meter which is based on the above electrometer circuit and a Freon (CCl_2F_2) pressure chamber is giving very satisfactory services both in plant and laboratory use. Circuit diagrams and photographs of the instrument are given.

94 Portable Alpha-Activity Measuring Instrument, by C. S. Wu and L. J. Rainwater. AECD - 2051 (DR - 288), May 25, 1945, decl. June 8, 1948. 20 p. (Informal disposition. This also includes declassification of the portable alpha-activity measuring instrument). For sale by AEC.

A portable sensitive alpha-particle detector has been developed for scanning and surveying small amounts of U-metal on various surfaces. Although there are various possible ways of detecting alpha-particles, for the sake of simplicity and serviceability, the method using an ionization chamber in connection with a portable electrometer circuit is employed. Units built in the laboratory have proven very satisfactory. The high sensitivity that has been achieved with these instruments approximates counter sensitivities.

With the size of the ionization chamber described (diameter 2 1/2", depth 1 1/4") and an input resistance of 5×10^{11} ohms, 0.30 mg of normal U-oxide gives one quarter of full scale deflection on the most sensitive range. It is rather easy to detect 0.10 mg of normal U-oxide. Since 0.30 mg of normal U-oxide emits only three alpha-particles per second in the upward 2π solid angle, the number of alpha-particles which get into the chamber can hardly be more than half of this value or 1.5 alpha/second. Because of the random emission of alpha-particles from any radioactive source, the only limitations on further extending the sensitivity of this type of instrument are the statistical fluctuations. Even in the present unit, the individual alpha-kicks are easily observable and statistical fluctuations make the taking of a reading very difficult. Circuit diagrams are included.

INSTRUMENTS

95 Recording Dosimeters for One Microsecond X-Ray Pulses, by J. S. Allen and D. E. Hudson. AECD - 2052 (LADC - 232), May 25, 1945, decl. June 15, 1948. 20 p. (Disposition as required for use in research, development, or manufacturing work. This includes declassification of the recording dosimeter). For sale by AEC.

The use of Westinghouse "micro-flash" X-ray equipment for routine investigations has shown the need of a device for measuring the relative integrated intensity of each X-ray pulse. To satisfy this need two types of ionization chambers have been developed whose voltage outputs are proportional to the integrated intensity of a single X-ray pulse, provided the spectral distribution of the X-rays remains reasonably constant. The electronic circuits required to operate a recording meter are described.

96 Multivibrator Quenching of Geiger-Mueller Tubes, by B. J. Thamer and A. F. Voigt. AECD - 2064, n.d., decl. June 15, 1948. 13 p. (For oral presentation before a meeting of the American Physical Society to be held in June 1948, in Madison Wisconsin). For sale by AEC.

An abstract of this document has previously been issued as AECD - 1941 and listed in Abstracts of Declassified Documents.

97 Alternating-Current Arc with Electron-Tube Control for Spectrographic Analysis, by N. F. Vollerner. Zavodskaya Laboratoriya 13, p. 1215-1217, October 1947. (In Russian).

Gives circuit details of above installation, which results in greater are stability and greater ease of adjustment.

98 Apparatus and Measurement Method for Radioactive Biological Preparation, by G. Joyet. Helvetica Physica Acta 20, p. 247-249, 1947.

An apparatus for measuring the radioactivity of ashes of biological origin is described. The apparatus is kept at constant temperature in a thermostat in order to reduce variations of the counter tube. Radioactivity measurements of K^{42} and Fe^{59} have been made. Correction formulae for absorption within the sample are developed; the formula is linear for K^{42}, but is more complicated for Fe^{59}.

99 Apparatus for Weighing in Vacuum, by G. W. Monk. Journal of Applied Physics 19, p. 485-486, May 1948. (MDDC - 1307).

An apparatus is described which can be used to measure the weight of a sample in a vacuum (0.01 micron) at temperatures up to about 700°C. Typical preliminary results are given for the outgassing of aluminum, carbon, and "Teflon".

INSTRUMENTS

100 Construction and Performance of a Low Voltage Arc as a Source of Positive Ions, by Samuel K. Allison. Review of Scientific Instruments 19, p. 291-298, May 1948.

A low voltage arc of the "capillary" type which has given reliable performance since its installation in 1940 is described. The design stresses simplicity and reliability but no special attempt is made to attain very low consumption of gas. Operating at an arc current of 0.75 ampere and consuming 25 cc of deuterium at N. T. P. per hour, a total beam current of 1.1 milli-ampere is produced with a probe potential of 3500 volts. About 50 microamperes of deuterons, magnetically selected from this beam, can be focused on a target.

101 Determination of Small Magnitudes by Means of Electrons, by E. Bruche. Physikalische Blätter 3, p. 114-117, 1947.

A review dealing with the determination of small lengths and the dimensions of small particles by means of the electron microscope.

102 An Improved Radioactivity Measuring Cup, by Robert E. Smith and John F. Bronson. Science 107, p. 603, June 4, 1948.

An improved radioactivity measuring cup is described which is a modification of the type developed by Labaw. Sample cups of the design reported have been successfully used by the authors in radioactivity measurements of P^{32}, I^{131}, and Co^{60}.

103 A Positive Ion Source, by A. J. Bayly and A. G. Ward. Canadian Journal of Research 26, p. 69-78, March 1948. (NRC - 1703)

Positive ions are formed in a low pressure electrodeless discharge which is excited by the radio-frequency field of a coil coupled to a 15 Mc. per second oscillator. The ions are extracted from the discharge through a pumping canal (2 mm in diameter x 12 mm in length) by a simple arrangement of electrodes. After further-focusing and acceleration + 8 50 kv., the beam current at the target is 500 μa. and the focal spot is 6 mm in diameter. Magnetic analysis has shown that the beam consists of 50% protons when using hydrogen in the discharge and 60% deuterons when using deuterium. Gas is supplied to the source at the rate of 15 cc per hr.

104 A Powerful Light Source for the Illumination of Wilson Cloud Chambers, by N. Warmoltz. Applied Scientific Research B 1, p. 139-142, 1948.

A capillary flash-tube is described for photographing the tracks in a Wilson cloud chamber. At an energy input of 500 watt-seconds per flash and with a choke in series with the flash-tube, the light output amounts to 15000 lumen-seconds per flash. At that energy and at a rate of 8 flashes per minute, the lifetime of the tube exceeds 100,000 flashes. At about 320 Watt-seconds light output is amply sufficient for photographing cloud chamber tracks.

INSTRUMENTS

105 The Recovery of the Wilson Cloud Chamber Working With Constant Final Pressure, by P. M. Endt. Physica 14, p. 29-34, January 1948.

The various effects influencing the recovery of the Wilson cloud chamber working with constant final pressure are mentioned. In particular the temperature changes after an expansion and after a compression are calculated. Also the case of a regular succession of expansions and compressions is treated. A simple method is given for finding the sensitive time and the recovery time.

106 The Recovery of the Wilson Cloud Chamber Working with Constant Final Volume, by P. M. Endt. Physica 14, p. 97-103, April 1948.

The temperature in the middle of the chamber after an expansion with constant final volume is calculated with the method of Laplace transformation and compared with the approximations made by van Heerden and Williams.

The Wilson chamber operates best (long sensitive time, short recovery time) with constant final pressure after the expansion but with constant final volume after the compression. The recovery time is calculated for this case.

107 Self-Delayed Coincidences with Scintillation Counters, by S. DeBenedetti, F. K. McGowan, and J. E. Francis Jr. Physical Review 73, p. 1404-1405, June 1, 1948. (AECD - 1855).

It is possible to measure time intervals between two ionizing events by studying the distribution of pulses from a single detector provided the dead time of the detector is smaller than the interval to be measured. With scintillation counters, which supposedly have a very short dead time, the method of self delayed coincidences should be capable of measuring very short intervals. To test this point a source of Hf^{181} (known to decay into Ta^{181*} of 22 μ seconds half-life) was located close to a clear anthracene sample ($\sim$.5 x 1 x 2 cm); on the opposite side, at a distance of 0.3 cm, was the glass wall of a 1P21 photomultiplier tube, operating at 60 volts per stage. The pulses from this tube, after amplification, were fed to a self delayed coincidence circuit. With this arrangement it was possible to measure the half-life of Ta^{181*} obtaining a value in good agreement with previous determinations.

In the following table counting rates (counts/minute) of single counts and delayed coincidences (for the same source and with same delay and resolving times) are shown

	Geiger Counters	Anthracene Counters
Background (single counts)	$\sim$20	150
Single counts from source	9600	7200
Delayed Coincidence	230	130

This indicates that anthracene scintillation counters are highly efficient, not only for the main radiation from Hf^{181}, but also for the radiation of Ta^{181*} which consists of electrons and gammas of around 100 Kev.

INSTRUMENTS

108 Self-Quenching Halogen-Filled Counters, by S. H. Liebson and H. Freidman. Review of Scientific Instruments 19, p. 303-306, May 1948.

Counters filled with small percentages of the halogens mixed with the inert gases produced self-quenching counters. The lifetimes of these counters in terms of total counts are apparently unlimited. Several mixtures exhibited thresholds below 250 volts at total pressures ordinarily used in counters. Pulse size, efficiency, and quenching characteristics are similar to those obtained with argon-alcohol Geiger-Mueller counters filled with a ten per cent mixture to total pressures in excess of 10 cm Hg. The percentages of halogens required to make good counters were about the same as the optimum concentrations reported for quenching metastable states in the rare gases.

109 The Use of Anthracene as a Scintillation Counter, by P. R. Bell, Physical Review 73, p. 1405-1406, June 1, 1948. (AECD-1854).

Anthracene has proved more satisfactory for scintillation counters than naphthalene. Cobalt-60 gamma rays produce 3.5 times larger pulses in anthracene than in naphthalene permitting the use of a lower background counting rate. A polonium beryllium neutron source gave five times greater counting rate with anthracene than with naphthalene. The maximum pulse size was also five times as great in anthracene. By means of absorption curves in lead and cadmium, the counts were shown to be due to fast neutrons. The neutron detection efficiency seems to be about 10 per cent.

110 The Use of Thoria-Coated Filaments in the Mass Spectrometer Leak Detector, by T. E. Hanley. Review of Scientific Instruments 19, p. 369, May 1948.

One of the problems encountered in the mass spectrograph leak detector is that of obtaining a reasonable life from the filament used as the emitter. At the Naval Research Laboratory it has been found possible to increase, by a factor of at least 10, the life of the tungsten filaments which normally gave about 4 hours of operation. This was done by coating them cataphoretically with thoria.

ISOTOPES

111 Atomic Energy Developments; Press Notice. Great Britain, Ministry of Supply, May 10, 1948.

The new atomic pile at Harwell is expected to come into operation this summer when a much larger number of radioactive isotopes, with greater strength, will be produced than at present with the low-energy experimental pile. Processing, packing, and distribution of isotopes produced at Harwell will be carried out by the Radiochemical Centre at Amersham. Isotopes of approximately 30 different elements, some of which are very rare, have so far been produced in varying quantities. Radio-sodium has been prepared in the greatest quantitites. An important part of the work carried out at Harwell is the design of safe packages for transporting radioactive material.

ISOTOPES

112 The Distribution of Potassium Isotopes in Biological Material, by Lorin J. Mullins and Karl Zerahn. Journal of Biological Chemistry 174, p. 107-113, May 1948.

The K^{40} content of potassium from animal, vegetable, and mineral sources has been compared with reagent KCl. No difference in K^{40} content within ± 0.5 per cent could be demonstrated for these various materials.

ISOTOPES SEPARATION

113 Concentration of N^{15} in a Gaseous Exchange Column, by T. I. Taylor and William Spindel. Journal of Chemical Physics 16, p. 635-636, June 1948.

The concentration of N^{15} in a gaseous exchange column using the reaction $N^{15}O + N^{14}O_2 \rightleftarrows N^{14}O + N^{15}O_2$ is described.

114 Direct Measurement of Rare Gases Produced in Uranium Fission; A New Isotope of Krypton, by W. Seelmann-Eggebert. Naturwissenschaften 28, p. 451-455, 1940.

A method of isolating and examining gases formed in fission reactions is described. Examination of the rare gases found in primary products of U fission with Ra-Be neutrons has revealed a new Kr isotope with half-life 2.5-3 minutes which gives a Rb isotope with half-life 15.5 minutes. Products remaining after 2.5 hours include 170-minute Kr, 18-minute Rb, and a 9-hour Xe which is formed from a 6.6-hour I. 33-minute Cs is formed from a parent substance with half-life 16-18 minutes and yields a Ba which is either inactive or almost completely so.

115 Krypton and Xenon Arising from Fission, by S. Epstein. Proceedings of the Conference on Nuclear Chemistry, Chemical Institute of Canada, p. 108-116, 1947.

The quantitative separation of gas mixtures resulting from uranium fission was carried out by fractional adsorption on charcoal. The greatest difference in adsorption between argon and krypton occurred when the charcoal was at $-80°C$; and between krypton and xenon when the charcoal was at $-20°C$. With two samples of uranium metal differing in weight and irradiation time, the xenon-krypton ratio was 5.03 and 5.06 respectively. Using abundance data obtained with the mass spectrometer and the xenon-krypton ratios, the relation of the various isotopes to one another and between samples is calculated. The apparatus and instruments used are described in detail.

ISOTOPES SEPARATION

116 Process and Method for the Electric Separation of Nuclear Isomers, by A. S. Laramyan, and L. I. Rusinov. Doklady Akademii Nauk SSSR 58, New Ser., No. 4, p. 573-576, 1947. (In Russian)

The authors discuss the processes involved in the separation of radioactive bromine atoms from ethyl bromide that has been subjected to the radiation of slow neutrons. The behavior of the resulting isomers Br^{80*} and Br^{80}, which retain their beta-ray intensity long after discontinuation of the neutron bombardment, is described. Graphs and a bibliography are included.

117 Separation of the Krypton and Xenon Isotopes Formed in Uranium Fission, by O. Hahn and F. Strassmann. Naturwissenschaften 28, p. 455-458, 1940.

The Kr and Xe formed in U fission have been separated quantitatively by condensation in active C adsorption vessels cooled respectively with CO_2-ethyl alcohol and liquid air. The Kr isotopes found as primary products are: short-lived Kr → 80-second Rb → 6-day Sr → 3.5-hour Y; 2.5-3 minute Kr → 15.5-minute Rb → 54-day Sr → Y; and 170-minute Kr → 18-minute Rb → stable Sr.

LABORATORIES

118 The Argonne National Laboratory, by Farrington Daniels. Bulletin of the Atomic Scientists 4, p. 177-180, June 1948.

This article describes the history, organization, and future plans of the Argonne National Laboratory.

119 Atomic Research Center. Ordnance 32, No. 165, p. 175, November-December 1947.

This is an outline of the organization and facilities of the Brookhaven National Laboratory where fundamental research on the nature, properties, and applications of atomic energy is being conducted.

120 Design of Laboratories for Radioactive Work, by Robert Spence. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 212-213, 1947.

The various precautions which must be taken in designing radiochemical laboratories are discussed.

121 Tracerlog. Boston, Tracerlabs Inc., 1948. 12 p.

The February 1948 issue of Tracerlog describes a new laboratory monitor. It also contains an article on the practical aspects of the operation and administration of a laboratory for producing radioisotopes.

METALLURGY

122 Preferred Orientation in Rolled and Recrystallized Beryllium, by A. Smigelskas and C. S. Barrett. AECD - 2063 (ANL-HDY-494), May 1948, decl. June 18, 1948. 20 p. (For publication in a suitable journal). For sale by AEC.

The deformation and recrystallization orientations of the metal beryllium are reported. Some samples rolled at elevated temperatures, as well as those rolled at room temperature, were studied. The rolling texture of beryllium is one in which the preferred position of the basal plane is parallel to the plane of the rolled sheet and close-packed rows of atoms in this plane lie 30 degrees from the rolling direction. There is a scatter of from 40 to 65 degrees in both directions from this orientation around the rolling direction as an axis, and a smaller scatter around the transverse direction in the sheet. The texture is approximately the same for rolling at room temperature, 350, and 800 degrees C, and after recrystallization. There is no evidence of a change of slip mechanism with temperature.

123 The Inorganic Chemistry of Some Metallurgical Processes, by A. J. E. Welch. Annual Reports on the Progress of Chemistry 43, p. 129-137, 1947.

Reviews the following recent developments in production of metals by chemical and electrochemical processes: extraction of magnesium (particularly from sea water); production of highly electropositive metals by thermal reduction processes; extraction of alumina and aluminum from clay; and the extraction chemistry of beryllium and zirconium.

124 Production of Beryllium Compounds, Metal and Alloys, by Henry C. Kawecki. Transaction of the Electrochemical Society 89, p. 229-236, 1946.

Various uses of the metal beryllium are briefly reviewed. The chemical processing of the mineral beryl is described, and the fluoride process of preparing beryllium oxide is given in detail. Several electrolytic and electrothermal methods of reduction of beryllium are outlined. 14 references.

125 Production of Radium in Cornwall, by M. Gregory. Transaction of the Royal Geological Society of Cornwall 17, p. 306-312, 1946.

The extraction processes used from 1910 to 1927 are described.

MINERALOGY

126 Quick Uranium Assay. Chemistry 21, p. 12, May 1948.

The quickest way of estimating the amount of uranium in an ore is to compress the mineral into a small pill and then measure its radioactivity with a Geiger counter.

MINERALOGY

127 Radioactive Minerals of the Venezuelan Andes, by J. C. Davey. Transactions of the Royal Geological Society of Cornwall 17, p. 313-316, 1946.

Deposits are described of a carnotite-like mineral from a granite pegmatite near Timotes and of pitchblende from a granite pegmatic near Merida.

128 Radioactivity and Grain Size of Soil, by P. J. Hoogteijling and G. J. Sizoo. Physica 14, p. 65-72, April 1948.

By measurements on separated grain size fractions 0-2μ, 2-16μ, 16-2000μ of several sedimentary soils, evidence was found for a preference of the radioactive elements for the grain sizes 2-16μ. From the variation of the activity with the amount of the material spread each time on the same surface, as well as from the comparison of the radium content with the total activity, it was concluded that the composition of the radiation depends on the fineness of the material. The ratios of the concentrations of the various radioactive elements, therefore, must vary with the grain size. It is suggested that this variation is not only related to the mineral composition of the original material, but also influenced by the combined processes of solution and adsorbtion during the process of sedimentation.

129 Thorium Minerals. Chemistry 21, p. 5-6, May 1948.

It is not uncommon for certain primary uranium minerals, more especially those found in pegmatites, to contain moderate amounts of thorium. Certain varieties of uraninite, the crystal form of pitchblende found only in pegmatites, are fairly rich in thorium, but, on the whole, straight thorium minerals which might be regarded as commercial sources of the element are much less common than uranium minerals and only a few are known. Most of even these few are of rare occurrence and of only mineralogical interest, and up to the present practically the entire world supply of thorium has been obtained from the mineral monazite. The richest thorium mineral known is thorianite, a black, heavy metallic mineral which occurs in small cubic crystals in pegmatites. Allanite is a complex mineral containing cerium and other rare earth elements; it may carry up to 3% thorium.

130 Uranium Prospecting, by Hugh S. Spence. Chemistry 21, p. 1-5, May 1948.

The Canadian Government, through its Bureau of Mines, has issued this information on how uranium minerals occur and how to look for them. Great Bear Lake in northwestern Canada has rich uranium deposits.

131 Zirconium from the Region of Pocos de Caldas (Brazil), by R. Ribeiro Franco and W. Loewenstein. American Mineralogist 33, p. 142-151, 1948.

Crystalline zircon occurs with radiating fibrous zirconium oxide. This oxide is isotopic and amorphous to X-radiation. Analysis by spectrographic methods disclosed the presence of hafnium, but failed to reveal columbium, tantalum or thorium.

NEUTRONS

132 Theory of Oscillating Absorber in a Chain Reactor, by A. M. Weinberg. AECD-2044, n.d., decl. June 7, 1948. 22 p. (For publication in Physical Review)

The response of a critical chain reacting pile to a thermal neutron absorber which is oscillated back and forth inside the pile is calculated. It is shown that at frequencies which are low compared to the periods of delayed neutrons, the neutron intensity in the pile rises and falls as a whole, the shape of the stationary distribution always being maintained. As the frequency of the oscillation increases the nature of the neutron response changes from the overall fluctuation characteristic at low frequency to a propagated and attenuated neutron wave which emanates from the neighborhood of the oscillator. These neutron waves set up at high frequencies are entirely analogous to the familiar thermal waves which are established in Angstrom's method of measuring thermal conductivities. It is pointed out that since the pile equations are linear, the amplitude of the oscillating response is proportional to the total neutron absorption of the oscillated absorber, and therefore a known and an unknown absorber can be compared by observing the magnitude of the neutron oscillations caused by each.

133 The Mathematical Development of the End-Point Method, by S. Frankel and S. Goldberg. AECD - 2056 (LADC - 76), April 10, 1945, decl. June 17, 1948. 67 p. (For publication in Physical Review)

The end-point method is mathematically developed and its application to the Milne kernel studied in detail. The general solution of the Wiener-Hopf integral equation is first obtained. The Milne kernel appears in applying this method to the integral equation describing the diffusion and multiplication of neutrons in multiplying and scattering media. The neutrons are treated as monochromatic, isotropically scattered, and of the same total mean-free-path in all materials involved. Only problems with spherical symmetry are treated, these being reducible to equivalent infinite slab problems. Solutions are obtained for tamped and untamped spheres; in the former case both growing and decaying exponential asymptotic solutions in the tamper are treated in detail. Appendix I treats the effects of the approximations inherent in the end-point method. Apendix II gives the solution of the inhomogeneous Wiener-Hopf equation.

134 Activities Produced by Bombardment of TiO_2 with Pile Neutrons, by R. E. Hein and A. F. Voigt. AECD-2058, n.d., decl. June 15, 1948. 10 p. (For oral presentation before a meeting of the American Physical Society held June 21-23, 1948, in Madison, Wisconsin). For sale by AEC.

An abstract of this document has previously been issued as AECD - 1944 and listed in Abstracts of Declassified Documents.

135 Angular Distribution of Neutrons inside a Scattering and Absorbing Medium, by P. R. Wallace. Canadian Journal of Research 26, p. 99-114, March 1948.

A method is developed for determining the moments of the angular distribution of monoenergetic neutrons diffusing inside a homogeneous medium. It is applicable to the 'asymptotic' region, i.e., the

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region in which surface effects may be neglected. In particular, a general derivation is given for the current-density relation, involving no assumptions about the relative cross section for scattering and capture. The second moment is expressed in terms of derivatives of the density, and the analogous procedure for higher moments is indicated. Moments of the angular distribution relative to arbitrary directions in space are defined: general formulae and applications to special cases are given for the second moment. Comparison may be made with the results of elementary diffusion theory, in which the angular distribution is assumed to be essentially linear.

136 Comparison of Cross-Sections for the Capture of 220 and 900 Kev Neutrons, by R. Allen, G. R. Bishop, P. Demers, and H. Halban, Nature 161, p. 727, May 8, 1948.

The capture cross-sections of a number of nuclei for neutrons of 220 and 900 Kev are compared. Experimental procedure is described. The ratios of cross-sections for the following active isotopes are given: Al^{28}, Mn^{56}, Cu^{64}, Cu^{66}, As^{76}, Br^{80}(18 min), Br^{80}(4.4 hr), Br^{82}, Rh^{104}(94 sec), Rh^{104}(4.2 min), $Pd^{104, 109}$, Pd^{111}, Ag^{108}, Ag^{110}, In^{116}(54 min), Sb^{112}, I^{128}, Ba^{130}, Te^{131}, Dy^{165}, W^{187}, Pt^{199}, Au^{198}.

137 Crystal Orientation in Al by Slow Neutron Diffraction, by G. Arnold and A. H. Weber. Physical Review 73, p. 1385-1389, June 1, 1948.

Investigations are described of crystal orientation effects in various forms of aluminum by measurement of total cross sections in the neutron energy range 0.003 to 0.05 ev approximately.

138 Equilibrium Abundances of Isotopes, by K. S. Singwi and R. N. Rai. Proceedings of the National Institute of Sciences of India 12, p. 291-300, 1946.

The temperature and neutron concentration of an assembly in thermodynamic equilibrium was determined by means of relative isotope abundance data. Various combinations of isotope pairs give widely different values for temperature and neutron concentration. An assembly consisting of electron, positrons, nucleons, and alpha particles is also considered.

139 High Energy Neutron-Proton Scattering, by G. F. Chew and M. L. Goldberger. Physical Review 73, p. 1409, June 1, 1948.

The scattering of high energy neutrons by protons has been investigated with the interaction potential given by the symmetrical meson theory with the tensor force omitted. The method of phase shift was used. The results at 80 Mev are tabulated with the square well and Born approximation figures given for comparison.

NEUTRONS

140 Inelastic Scattering of Fast Neutrons by Fe, Pb, and Bi, by L. Szilard, S. Bernstein, B. Feld, and J. Ashkin. Physical Review 73, p. 1307-1310, June 1, 1948 (MDDC-1536).

Measurements of inelastic scattering effects of Ra-α-Be and Ra-α-B neutrons in Fe, Pb, and Bi have been made. A U^{238} fission threshold detector was used. The method consisted in measuring the fission counting rate in the detector with and without the spherical scatterer surrounding the source. From the decrease in the counting rate caused by the presence of the scatterer, values of the cross section for inelastic scattering to below U^{238} fission threshold were calculated for several assumed values of the elastic scattering cross section.

141 Neutron Polarization by D. J. Hughes, J. R. Wallace, and R. H. Holtzman. Physical Review 73, p. 1277-1290, June 1, 1948. (MDDC - 809, 849, 873).

The production of polarized neutrons in magnetized iron has been studied, using the intense neutron beams available at the Argonne heavy water pile. The theoretical work of Halpern et al., used as a guide in the experiments, has been checked in many respects, with the exception that the polarization cross section p has a measured value of 3.15 barns compared to the theoretical 1 barn. The application of neutron polarization to the measurement of the approach to saturation in ferromagnets is described and preliminary results are reported.

142 Scattering of 100 Mev Neutrons by Protons, by F. C. Barker. Nature 161, p. 726-727, May 8, 1948.

Calculations of the differential cross-section for the scattering of 100 Mev neutrons by protons have been made, using an exponential-well potential $V_o e^{-r/a}$ with two values of the range a. The depths of the triplet and singlet interactions, determined from the deuteron binding energy and the cross-section for the scattering of slow neutrons by protons, were respectively 313.5, 191.2 Mev for $a = 0.5 \times 10^{-13}$ cm., and 98.4, 60.0 Mev for $a = 1.0 \times 10^{-13}$ cm. The two cases of exchange forces and of symmetric forces were assumed.

143 Slow Neutron Experiments in Groningen, by D. Coster, H. Groendijk, and Hl. De Vries. Physica 14, p. 1-7, January 1948.

Values are given for the energies and the effective widths of the resonance levels of the following nuclei Au^{198}, Ag^{108}, Ag^{110}, Cu^{64}, Cu^{66}, Al^{28}, Zn^{69}, and Cd^{117}. They have been derived from previous measurements applying a correction for impurity of the boron samples used. The corrected values for the resonance energies, of Au and Ag are in agreement with those obtained by the time of flight method. It is shown that of the three levels of Ag (5.1, 16 and 45 Ev), the first belongs to Ag^{110} (22 sec) and the second of Ag^{108} (2.3 min). Overlapping levels of Ag^{110}, Cu^{66}, and Cd^{117} were found at about 100 Ev.

NEUTRONS

144 Slow Neutron Spectrometer Studies of Oxygen, Nitrogen, and Argon, by E. Melkonian, L. J. Rainwater, W. W. Havens, Jr., and J. R. Dunning. Physical Review 73 p. 1399-1400, June 1, 1948. (AECD - 1881).

A slow neutron velocity spectrometer was used to determine neutron cross sections of oxygen, nitrogen, and argon. The results obtained are compared with similar measurements made by Fermi and Marshall (Physical Review 71, p. 666, 1947).

145 Spatial Distribution of Slow Neutrons Produced in Water by a Radium-Beryllium Source of Fast Neutrons, by Andre Berthelot, Rebe Ballimi, and Leo Vermaesen. Comptes Rendus 225, p. 292-294, 1947. (In French).

Using a radon-beryllium neutron source and nickel-manganese plates as detectors, the spatical distribution of slow neutrons in a tank of water was determined.

NUCLEAR PHYSICS — METHODS OF MEASURING

146 Treatment of Experimental Data; Radiations, by L. Winsberg. AECD - 2047 (ANL-HDY-492), January 1947, decl. June 8, 1948. 19 p. (For use in lectures and seminars). For sale by AEC.

This document consists of an outline and discussion on radiations and energy determination. Electrons, positrons, X-radiation, and γ-radiation are the types of radiation included.

A list of 32 references is given.

147 Achromatization of Debye-Scherrer Lines, by H. Ekstein and S. Siegel. Physical Review 73, p. 1207-1208, May 15, 1948.

The ultimate limit of precision in lattice parameter measurements by the Debye-Scherrer method is given by the spectral width of the primary characteristic radiation. A method is given for sharpening the diffraction line by achromatizing the characteristic radiation; by causing all rays of wave lengths belonging to a spectral line to converge to a focus after diffraction.

148 Alpha-Particle and Deuteron Tracks in Eastman NTA Photographic Plates, by Robert L. Brock and Eugene Gardner. Review of Scientific Instruments 19, p. 299-303, May 1948.

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Eastman NTA photographic plates have been bombarded with alpha-particles and deuterons in the 184-in. Berkeley cyclotron, and photomicrographs of sections of tracks have been made and are reproduced in this paper. The trajectories do not lie in the emulsion for the entire range of the particles, and only short sections of track are available for study. In the tracks of low energy alpha-particles, and low energy deuterons, there are enough developed grains so that the tracks are nearly continuous. As the energy increases, the number of developed grains in the track decreases, the number for the deuterons decreasing more rapidly than that for the alpha-particles. In the tracks of alpha-particles of 200 Mev and lower, and of deuterons of 20 Mev and lower, there are enough developed grains so that the tracks can be followed easily.

149 Detecting Atomic Particles, by Serge A. Korff. Physics Today 1, p. 12-13, June 1948.

A review of the methods available for detecting and identifying protons, positive and negative electrons, neutrons, mesotrons, alpha particles, deuterons, and photons.

150 An Equation for the Curve I = f (N) Connecting the Luminous Flux Received by a Photon Counter with the Number of Discharges Counted, by S. Lormeau. Comptes Rendus 225, p. 865-867, November 10, 1947. (In French).

A good approximation to the experimental curves is given by the equation $I = C(a^N - 1)$, or with reasonable accuracy $I = aN + bN^2$ where b/a varies little from one curve, or one counter, to another.

151 A Rapid Method for the Determination of the Maximum Energies of β-Emitters with Simple Spectra, by L. Yaffe and Katherine M. Justus. Physical Review 73, p. 1400-1401, June 1, 1948.

Samples were mounted on Formvar films (50 mg/cm^2) and had such specific activity that no solid deposit was visible after the solution was evaporated on the film. Measurements were made using an "end-on" Geiger counter with mica window 2.8 mg/cm^2. The sample was placed in position about 1 cm from the counter window and counted first without any back-scattering, save for air, and secondly by placing a piece of metal directly beneath the film (Pb or Ag, 55 mg/cm^2). β-emitters used in this case were C^{14}, S^{35}, P^{32}, I^{131}, Co^{60}, Rh^{106}. This method, although only suitable for β-emitters with simple spectra, is useful for rapidly determining radioactive purity after chemical separation. It can also be used for a swift determination of the maximum energy value of emitters with half-lives too short for absorption measurements and can be done with only several hundred disintegrations per minute. A double value will be obtained in a few cases. This can be resolved by one absorption measurement.

NUCLEAR PROPERTIES

152 Binding Energies of Alpha-Particles in Medium-Heavy Elements, by T. P. Kohman. AECD - 2060 (ANL-HDY-493), May 1, 1948, decl. June 11, 1948. 6 p. (For oral presentation before a meeting of the American Physical Society to be held June 21-23, 1948, and for publication as a Letter to the Editor of Physical Review) For sale by AEC.

A discussion of alpha-particle binding energies based on the "empirical" atomic mass equation of Bohr and Wheeler is presented, with particular reference to the medium-heavy elements. Evidently most nuclides above A (mass number) = 140 are energetically capable of emitting α-particles, and are only stabilized by the nuclear potential barrier resulting from the high charge. Since the present experimental upper limits for α-activity for most β-stable nuclides correspond to lifetimes of only 10^{12} to 10^{14} years, it is possible that the lighter naturally-occurring isotopes of some of the even elements in this region may exhibit barely detectable α-activity.

Far to the neutron deficient side of the β-stability region, α-activity should be an important mode of decay. As A becomes smaller for a given Z, the lifetimes against α-decay will rapidly become shorter. At the same time the lifetimes against electron capture or positron emission will also decrease, so β-decay will probably be the predominant mode except for very light isotopes.

153 Atomic Energy Levels. National Bureau of Standards Technical News Bulletin 32, p. 74, June 1948.

An extensive research program is under way in the Bureau of Standards spectroscopy laboratory to make a complete and up-to-date compilation of the energy levels of the elements as derived from observations of atomic spectra. The data, which will include all information on atomic energy levels accumulated in the past 15 years as well as previously available material, are being published in pamphlet form by the Bureau of Standards. As each major portion of the work is completed, these pamphlets will be assembled into volumes of about 500 pages as NBS Circular C467. Section 1 of this circular, hydrogen through fluorine, which covers 45 spectra, has recently been published and is for sale by the Government Printing Office.

154 Beta Disintegration; Electron Creation, by Raymond Daudel, Maurice Jean, and Marcel Lecoin, Comptes Rendus 225, p. 290-292, 1947. (In French)

Electron creation results when an electron emitted in beta disintegration remains in the peripheral layer of the atom. The various effects accompanying electron creation are discussed. Emission will occur simultaneously with electron creation if the energy of transition (Z, Z + 1) is at least 500,000 ev.

155 Influence of Ionization on the Period of Electron Capture, by Pierrette Benoist. Comptes Rendus 226, p. 243-245, 1948. (In French)

The influence of ionization on the capture of peripheral electrons by the nucleus is discussed. In the case of permitted transition, only s electrons have an appreciable capture probability; in the case of forbidden transitions, p and d electrons may also be captured.

NUCLEAR PROPERTIES

156 Hyperfine Structure in Line Spectra and Nuclear Spin, 2nd ed, by S. Tolansky. London, Methuen, 1948. 120 p.

157 Internal Conversion in Tungsten and Platinum, by M. V. Scherb and C. E. Mandeville. Physical Review 73, p. 1401-1402, June 1, 1948.

Beta-beta coincidences have been observed between nuclear beta-rays and conversion electrons for the simple beta-ray emitter Ta^{182}. Ta^{182} emits about sixteen converted gamma-rays; the maximum conversion electron energy appears to be 0.135 Mev. The total conversion coefficient could not be calculated. Beta-beta coincidences in the disintegration of Ir^{192} have also been investigated. The total conversion coefficient was found to be 32 ± 3 per cent. No beta-beta coincidences were observed in Sc^{46}.

158 Nuclear Chemistry of Tellurium; Chemical Effects of Isomeric Transition, by Russell R. Williams, Jr. Journal of Chemical Physics 16, p. 513-519, May 1948. (MDDC - 1571)

The chemical consequences of isomeric transitions in the nuclei Te^{127}, Te^{129}, and Te^{131} have been investigated in aqueous solutions of varying composition. The nuclear reaction gives rise to chemical reduction or oxidation, and a mechanism has been proposed to account for the observed effects. Evidence has been advanced which indicates that the maximum efficiency of the chemical separation of the nuclear isomers can be taken as a measure of the degree of internal conversion.

159 Rotational Spectrum of $OC^{14}S$, and the Nuclear Spin of C^{14}, by Arthur Roberts. Physical Review 73, p. 1405, June 1, 1948.

The pure rotations transition $J = 1 \rightarrow 2$ of carbon oxysulphide, OCS, made with C^{14}, has been observed at 24, 173.0±1 mc, which agrees with the value predicted from the frequencies observed for isotopic molecules. No hyperfine structure as great as 0.5 mc is observable. The Stark effect pattern is visually identical with that of the C^{12} isotopic molecule, showing no sign of hyperfine structure. The l-type doublet due to molecules excited to the first vibrational bending mode ($V_2 = 1$) has been observed; these lines also show no hyperfine structure. With Townes estimate of $\delta^2V/\delta z^2$ in this molecule, this means that the quadrupole moment of the C^{14} nucleus is probably less than 10^{-27} cm^2. It is therefore concluded that the spin of C^{14} is most probably zero, in accord with the findings of Jenkins from band spectra (published after these measurements were made), and as yet unbroken rule that even-even nuclei have zero spin.

The l-type doublet of $O^{16}C^{14}S^{32}$ has the spacing 26.8±0.4 mc, as compared with 24.9±0.4 mc for $O^{16}C^{12}S^{32}$. The parameter α_2 of the bending vibrations is -9.4±0.3 mc as compared with -10.6±0.3 mc for $O^{16}C^{12}S^{32}$ (assuming symmetrical doubling of the rotational levels). The frequency of the C^{14} line was not determined with sufficient precision to check the accepted nuclear mass of C^{14}; because of the central position of the carbon atom, OCS is an unsuitable molecule for this purpose.

NUCLEAR PROPERTIES

160 Stability of Os^{187} against K Capture, by H. H. Seliger and H. L. Bradt. Physical Review 73, p. 1408-1409, June 1, 1948.

Naldrett and Libby have recently described experiments regarding the stability of the isobars Os^{187}–Re^{187}. The authors of this note investigated the problem sometime ago using a different method, and the results of the two independent experiments are compared.

NUCLEAR THEORY

161 Capture of Negative Mesons by Nuclei, by A. S. Lodge. Nature 161, p. 809-810, May 22, 1948.

Calculations are presented to substantiate the following theory: positively and negatively charged heavy mesons exist which differ only in their electric charge and which are to be identified with Powell's $\pi-$ and $\sigma-$ mesons respectively.

162 Correlation Between the States of Polarization of the Two Quanta of Annihilation Radiation, by E. Bleuler and H. L. Bradt. Physical Review 73, p. 1398, June 1, 1948.

The prediction that according to pair theory the planes of polarization of the two quanta originating in the annihilation of a positron should be perpendicular to each other has been verified by experiment.

163 New Neutral Particle, by V. B. Berestetskiy. Priroda, No. 1, January 1946. 2 p. (In Russian)

The author gives his opinion on data presented by Groetzinger, Kruger, and Smith in Physical Review 18, Nos. 1-2, 1945, in which the discovery of a hitherto unknown neutral particle is discussed.

164 Note on the Stability of Systems Containing a Light Positive Particle, by Aadne Ore. Physical Review 73, p. 1313-1317, June 1, 1948.

It is of interest to consider the dynamic stability of atomic or molecular systems which contain a positron, e.g., $e^+ Cl^-$. This paper examines what information about this stability that can be obtained without elaborate calculations, (a) from experimental data descriptive of hydrides and of the hydrogen molecule or molecular ion, and (b) from existing calculations of the energy of light polyelectrons. The procedure (a) suffices to guarantee stability only when the positron is replaced by a positive meson which has a mass of the order of twenty-electron masses or more. The second procedure allows a certain lowering of these approximate minimum mass values, in a special case to a few electron masses. The various numerical results are obtained very easily. They indicate that negative atomic ions can have a positive positron affinity.

NUCLEAR THEORY

165 Relationship Between Ionization Potential and Electron-Screening in the Period System, by W. Finkelnburg. Zeitschrift für Naturforschung 2a, p. 16-20, 1947.

The screening of the nuclear charge by means of inner electrons affects its action on the outermost electrons in a manner suggesting that it is governed by certain laws. The latter permit conclusions to be reached regarding conditions in the electron cloud of an atom. Extrapolation of unknown ionization potentials and correction of uncertain values are possible.

166 Synthetic Study of a Class of Elementary Particles, by L. A. Radicati. Nuovo Cimento 4, p. 251-261, October 1947. (In Italian).

Some properties common to a class of elementary particles of arbitrary spin are studied. In this class are comprised neutral and charged particles, and particles with zero rest-mass; in particular all the particles known at present. The theory predicts two kinds of particles with zero rest-mass, which can be distinguished by their behavior with respect to a generalized gauge-transformation of the second kind.

NUCLEAR TRANSFORMATIONS

167 Emission of Li^8 in the Explosive Disintegration of Nuclei, by C. Franzinetti and R. M. Payne. Nature 161, p. 735-736, May 8, 1948.

It has been recently been shown that unstable heavy nuclei are sometimes emitted during explosive disintegration produced in photographic plates by the passage of cosmic radiation. In some cases, these unstable particles, after being brought to rest in the emulsion, give rise to two particles of equal range, emitted in opposite directions. Data are presented showing that the characteristic tracks thus produced in the emulsion are due to the emission of a Li^8 nucleus during the disintegration which undergoes β-decay (0.88 second period), and simultaneously decomposes into two α-particles. Photographs and a chart are included.

168 Gamma Rays Produced in the Fission of U^{235}, by B. B. Kinsey, R. C. Hanna, and D. Van Patter. Canadian Journal of Research 26, p. 79-98, March 1948. (NRC-1723)

This paper describes measurements which have been made on the coincidence counting rate between the fissions produced in an ionization chamber and the discharges of a Geiger counter. By determining the absolute efficiency of the counter, the total energy emitted in the form of γ-radiation was estimated to be about 4.6 ± 1.0 Mev. Measurements have been made on the range of the electrons projected from an aluminum radiator placed between the ionization chamber and two thin-walled counters. From this experiment, the average energy of the radiation appears to be about 2.5 Mev. The result is confirmed by absorption measurements in lead. The absorption curve indicates a fairly homogeneous radiation and gives some evidence for the existence of a softer component with an energy of about 500 Kev.

NUCLEAR TRANSFORMATION

169 The Light Particles Emitted with the Fission Fragments of Thorium, by Tsien San-Tsiang and Henriette Faraggi. Comptes Rendus 225, p. 294-296, 1947. (In French).

The traces produced by the fission of thorium with fast neutrons have been recorded photographically and studied. The formation of a light fragment of long range by either quadripartition or tripartition was not observed. The release of a short-range light fragment by bipartition was observed about one hundred times more frequently than was the release of such a fragment by tripartition. The ratio of the range of the two heavy fragments produced by tripartition was 1:2; this compares with a ratio of 1:3 for the heavy fragments produced by bipartition.

170 Nuclear Reactions of Arsenic with 190-Mev Deuterons, by H. H. Hopkins, Jr., and B. B. Cunningham. Physical Review 73, p. 1406, June 1, 1948. (AECD - 1838).

Bombardment of thin targets of pure arsenic ($_{33}As^{75}$) with 190-Mev deuterons has led to the observation of nuclear reactions in which some of the product nuclei are more than 20 mass units lighter than the target nucleus. Identification of these isotopes was based on chemical behavior and half-life determination. A table of the isotopes identified, with their half-lives and yields, is given.

171 Photo-Effects in Middle-Weight Nuclei, by L. I. Schiff. Physical Review 73, p. 1311-1313, June 1, 1948.

The statistical model is applied to (γ,p) and (γ,n) processes induced by Li γ-rays. It is shown that the assumption of a particular regularity for the residual nuclear states that can arise from the compound nucleus gives results that are in good agreement with recent experiments by Hirzel and Waffler.

NUCLEONICS

172 The Mysterious Meson; the Building-Stone of the Atom, by L. A. Sanders. Ryswick, England, Saunders-Saunders, 1947. 31 p.

173 The Ultimate Particles, by George W. Gray. Scientific American 178, p. 27-39, June 1948.

A comprehensive, non-technical review of the fundamental units of atomic structure and of nuclear forces. Tables, illustrations, and photographs are included.

PARTICLE ACCELERATORS

174 **Plan of 12 Mev Electrostatic Accelerator under Construction at Los Alamos, by J. L. McKibben. AECD - 2038 (LADC-522), n.d., decl. June 3, 1948. 16 p. (For oral presentation before a conference on Electrostatic and High-Energy Accelerators at M. I. T., June 7-10, 1948, and for publication in the Review of Scientific Instruments). For sale by AEC.**

Plans of the 12 Mev electrostatic accelerator under construction at Los Alamos are discussed. Some of the features of this maching are its use of a gas tight separation column around the charging belt and accelerating tube, use of capacitor liner of the tank for precision voltage control, use of a pivoted 90 degree deflecting magnet to bend the vertical beam horizontally, and ample space for clean neutron experiments.

175 **Measurement of the Electron Current in a 22-Mev Betatron by Leon Bess and A. O. Hanson. Review of Scientific Instruments 19, p. 108-110, February 1948.**

The magnitude of the charge circulating in a betatron orbit is determined from its magnetic effect. The results indicate that the charge accelerated to high energy per second, in a 22-Mev betatron operating at 180 cycles per second, corresponds to an average current of about 0.15 microampere. A diagrammatic illustration of the experimental arrangement is included.

Atomic Energy Commission declassified documents listed as available for sale may be obtained from:

Document Sales Agency
P. O. Box 62
Oak Ridge, Tennessee

PHYSICS, GENERAL

176 A Simplified Equation of State at High Pressures and Its Application to Surface Films on Liquids and Solids, by S. Ross and C. H. Secoy. AECD-2031 (ORNL-39), March 15, 1948, decl. June 2, 1948. 17p. (For oral presentation before a meeting of the East Tennessee Section of the American Chemical Society held June 5, 1948, and before the Twenty-Second National Colloids Symposium held June 23-25, 1948, and to be submitted for publication in the Journal of Physical and Colloid Chemistry). For sale by AEC.

An abstract of this document has previously been issued as AECD-1842 and listed in Abstracts of Declassified Documents.

177 Nucleon Bombarded Germanium Semi-Conductors, Part II, by R. E. Davis, W. E. Johnson, K. Lark-Horovitz, and S. Siegel. AECD-2054, n.d., decl. June 3, 1948. 6p. (For oral presentation at the following meetings: Joint Electron Army-Navy Panel - Crystal Symposium at Purdue University, June 19, 1948; American Physical Society meeting in Madison, Wisconsin, June 21, 1948; International Congress of URSI in Stockholm, Sweden, July 19, 1948). For sale by AEC.

The electrical behavior (conductivity, thermoelectric power, etc.) of germanium semi-conductors can be described quantitatively once the number of carriers is known. The number of electrons (N type conduction) or the number of holes (P type conduction), depending on the type and number of impurities present, can be determined from Hall effect measurements. It is assumed (and made plausible by experiment) that each impurity atom releases one carrier. Experiments conducted at Purdue Laboratories and in the Oak Ridge pile are described.

High-resistance non-homogeneous material shows a marked decrease in resistance when bombarded. Apparently the introduction of a large number of lattice vacancies diminishes the inhomogeneity of the original material caused by fluctuation in impurity content.

N-type germanium becomes converted to P-type material. This was shown by making Hall effect measurements on the material before and after bombardment. P-N type barriers similar to the naturally sporadic occurring P-N type barriers, are formed by bombardment. These can be detected by their rectifying properties and their photo-emf's.

The displacement of lattice points produces new scattering centers of two kinds: vacancies and displaced atoms. The continuous neutron bombardments over long periods also produce transmutations, thus leading to new impurity centers. The latter process, while negligible in the deuteron and alpha bombardment, introduces about 10^{-8} fractional atoms, and for high purity samples this is not to be neglected in the resistivity range where primarily intrinsic carriers are produced and are responsible for conductivity.

178 The Atom, by George Thomson, 3rd ed. New York, Oxford University Press, 1947. 196 p.

This is a concise presentation of the fundamental concepts of atomic theory. Atomic structure, quantum theory and wave theory of matter, radioactivity, and nuclear energy are discussed. The author concludes the discussion with a survey of some implications of the atomic theory, both scientific and philosophical.

PHYSICS, GENERAL

179 The Chemical Elements and the Isotopes in Relation to their Specific and Atomic Heats, by Victor Valenzuela Guardia. Boletin de la Sociedad Quimica del Peru 13, p. 118-126, 1947.

The coefficient $S = (301.8 + S_e - 20.76)/86$ with $S = 3.30$ applies to H isotopes as well as other elements. S_e = (atomic weight + atomic number)/(atomic number). Tables of atomic and specific heats and of S_e are given for isotopes of H, Tl, Pb, and radioactive elements 83, 84, 86, and 88-92. The (radioactive) power of disintegration, D, equals (atomic number) (atomic weight/0.606 S_e^2; values of D and of (calculated) specific heat are listed for the first 60 elements.

180 Classical Theory of Charged Point-Particles with Dipole Moments, by C. M. Lattes and others. Academia Brasileira de Ciencias Anais 19, p. 193-245, January 1947.

This paper considers briefly the geometrical properties of electric and magnetic dipoles; examines the fields of a point charge with dipole moments; discusses the equation of motion by Frenkel's method and Frenkel's variational principle which is modified for the reaction of radiation; developes a variational principle for the system of the field plus particles; introduced the conjugated momenta for the coordinates and spin variables of the particle by means of a method proposed by Schonberg, in which the conjugated moments are defined as functional derivatives of the action functional; and discusses the boundary conditions for the equations of the field and the particles on the basis of Schonberg's method.

181 "Energy Migration" in Crystals and Molecular Complexes, by N. Riehl. Naturwissenschaften 28, p. 601-607, 1940.

Instances of the rayless migration of absorbed radiant energy over considerable distances ($>10^3$ atomic diameters) are reviewed in connection with luminescence in α-rays, mutation of genes by X-rays, chlorophyll assimilation of CO_2, and fluorescence of polymerised dyestuffs. In the case of luminescence, a theoretical treatment based on the electronic theory of crystal structure is propounded.

182 The Formation of Metastable Atoms in Optically Clear Excited Mercury Vapors, by I. M. Gurevich. Doklady Akademii Nauk SSSR 57, New Ser., No. 7, September 1947. 4 p. (In Russian)

The author describes experiments conducted which serve as aids toward understanding the hypothesis of metastability. His results conformed with those obtained by Zemanskiy, Rouse and Giddings, and Houtermans.

PHYSICS, GENERAL

183 The Place of Physics in Australia, Part III. Australian Journal of Science 10, p. 97-104, February 21, 1948.

Contains general discussion of nuclear physics and comments on the state of nuclear physics in Australia.

184 Radiation of an Electron Moving in a Circular Orbit in a Space Enclosed by Metallic Walls, by M. L. Levin. Zhurnal Teknicheskoi Fiziki 17, p. 1159-1164, October 1947. (In Russian)

A mathematical development.

QUANTUM MECHANICS

185 Dirac's One-Electron Problem in Momentum Representation, by A. Rubinowicz. Physical Review 73, p. 1330-1333, June 1, 1948.

The eigenfunctions of the one-electron problem have been transformed into a form suitable for numerical calculations.

186 On the Fundamental Hypotheses of the Intermediate Statistics, by A. Borsellino. Nuovo Cimento 4, p. 52-62, February 1947. (In Italian).

The hypotheses of the statistics of Gentile are studied from the point of view of wave mechanics, and the difficulties are pointed out that arise if the symmetry properties of wave functions are considered for systems of particles obeying a generalized exclusion principle. In addition, a formula is discussed which is thought to represent correctly the statistical distribution within a gas constituted by a finite number of particles obeying Bose-Einstein statistics.

187 The Principles of Quantum Mechanics, 3rd ed., by P. A. M. Dirac. London, Oxford University Press, 1947. 311 p.

A symbolic approach to the subject including a new presentation of the theory of systems with similar particles, a further development of quantum electrodynamics, and theory of the Wentzel field.

QUANTUM MECHANICS

188 Quantum Theory of Condensed Permanent Gases, Part I; The Law of Corresponding States by J. De Boer. Physica 14, p. 139-148, April 1948.

It is shown, in a quite general way, that the equation of states of the noble gases, H_2, D_2 and N_2 can be written in a reduced form in which the thermodynamic quantities T, P, V, etc. are expressed in, molecular units" i.e. units obtained from the characteristic parameters of the intermolecular field. In general the reduced equation of states contains a parameter Λ^* containing also h and the mass of the molecules, which measures essentially the influence of quantum mechanics on the phenomenon considered. Only when classical statistic can be applied and $\Lambda^* = 0$, the reduced equation of states implies the law of corresponding states in its classical form.

The reduction with molecular units is applied to the condensed phase of the substances mentioned above to study experimentally the thermodynamical properties as a function of Λ^* and to obtain in this way information on the influence of quantum theory on these phenomena.

189 Transformation Theory Applied to a Radiation Field, by Jose A. Balseiro. Physical Review 73, p. 1346-1348, June 1, 1948.

Having given a photon distribution described by a field function in terms of an orthogonal system, the question arises as to what will be the photon distribution when the field is given in terms of another orthogonal system of functions. The problem is solved by means of transformation theory.

RADIOACTIVITY

190 Basic Concepts of Radioactivity, by W. H. Sullivan. Proceedings of the Conference on Nuclear Chemistry, Chemical Institute of Canada, p. 33-39, 1947.

A review of radioactivity, decay processes, nuclear reactions involved in the production of radioactivity, and interaction of nuclear radiations with matter.

191 Note on the "Natural Radioactivity of Rhenium", by Nathan Sugarman. Physical Review 73, p. 1411, June 1, 1948. (AECD-1844).

In examining the isobaric pair Re^{187}-Os^{187} for radioactivity, Naldrett and Libby found an activity in Re which they attributed to beta-radiations from Re^{187}. The samples were purified sufficiently to separate other elements with the exception of the chemically similar Tc. Since it appeared possible to the authors that the radiations observed might originate in a natural isotope of Tc present in the Re, the Re was subjected to chemical operations which were shown in tracer studies to free it of Tc, and then its activity was measured. The details of the chemical separation and the results of the activity measurements are given.

RADIOACTIVITY

192 New Radiations from a Member of the Thorium Family, by Alice Leigh-Smith and Oscar D'Agostino. Rendiconti Istituto di Sanita Publica 10, p. 523-534, 1947.

Using the methods of Leigh-Smith and Minder, an attempt has been made to separate element 85, astanine, from an active deposit of thorium. A product separated by sublimation at 130°C was introduced into a Wilson cloud chamber. The alpha particle tracks obtained were in most cases single, but in approximately 14 per cent of all cases, pairs of alpha particles with two different track lengths appeared. From energy considerations the authors believe that one of the two alpha components emitted is 86^{216} which was produced by the reaction:

$$\text{Th A} \xrightarrow{\beta} 85^{216} \xrightarrow{\beta} 86^{216}$$

The other alpha component is believed due to 84^{212}, an isomer of thorium C. Additional work testing this hypothesis is in progress.

193 Radioactive Series of Chemical Elements, by A. J. Cruikshank. Proceedings of the Conference on Nuclear Chemistry, Chemical Institute of Canada, p. 51-59, 1947.

Some of the descriptive aspects of the theory of radioactivity and of the 4 radioactive series are given; and the general plan of the investigations leading to the proof of the course of the Np (4n + 1) series is outlined briefly.

194 The Rate of Decay of Fission Products, by K. Way and E. P. Wigner. Physical Review 73, p. 1318-1330, June 1, 1948. (MDDC-1194).

By considering the fission products as a sort of statistical assembly, calculations have been made of the β-disintegrations per second and of the total energy emitted per second at any time after fission has taken place. The results are in good agreement with experiment. The theoretical work is based on the assumption that the mass of a nucleus of mass number A and charge Z is given by $a(Z_0(A) - Z)^2 + b$. Empirical values for a and b are used. Use is also made of an approximate empirical relationship between half-life and disintegration energy. A further basic hypothesis which is important for the results at very short times after fission has taken place is that, in the most probable way of splitting, the chain lengths of the light and heavy fragments are equal, and that there is not much deviation from this most probable mode of fission. The average number of β-disintegrations per fission is found to be 6; the average energy of all radiations (β, γ, and neutrinos) of the fission products is 21.5 ± 3 Mev. Apparently, about half of this energy escapes in the form of neutrinos and a quarter is emitted in the form of β and in the form of γ rays.

A few remarks are made concerning the possible origin of delayed neutrons. It is also pointed out that the spread of the kinetic energy of a given pair of fission fragments cannot be easily explained on the basis of differences of chain length which result in differences in excitation energy of the fragments. It is possible that fluctuations in the production of fission neutrons are at least partly responsible for the kinetic energy spread.

RADIOCHEMISTRY

195 The Effects of Pile Bombardment on Uncured Elastomers, by W. L. Davidson and I. G. Geib. Journal of Applied Physics 19,p. 427-433, May 1948. (MDDC - 1449).

Previous work on the effects of ionizing radiations on hydrocarbons has established that four competitive processes are usually operative: (1) dehydrogenation, (2) condensation or polymerization, (3) hydrogenation (action of nascent hydrogen on any unsaturated matter present), (4) decomposition (C-C cleavage). The chain reacting nuclear pile offers an ideal means for subjecting relatively thick samples of matter (such as rubber) to uniformly high concentrations of radiation. Such studies on natural rubber, butyl rubber, and polyisobutylene allow one to draw the following conclusions. 1. Uncured natural rubber undergoes a slight curing action when exposed to pile radiations. 2. Polyisobutylene samples are appreciably degraded by pile radiations. 3. The same effects as noted in (1) and (2) are greatly enhanced by secondary alpha-particles, produced by an (n, α) reaction on boron^{10} (milled into the elastomer). However, even a 2-hour bombardment of natural rubber yields a product greatly inferior to sulfur vulcanizates. 4. Pile bombardment does not introduce measurable unsaturation in polyisobutylene and decreases the unsaturation in natural rubber but slightly. 5. A typical butyl rubber stock is permanently degraded by pile irradiation, showing upon cure reduced tensile strength compared to that of control sample. 6. Natural rubber shows a weak but measurable radioactivity days after bombardment, probably because of its mineral content. Polyisobutylene is not appreciably active.

196 Radiation Chemistry; Effect of Resonance as Illustrated by Benzene, by Milton Burton. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 179-191, 1947. (See also MDDC - 17 and MDDC - 1655).

An introduction to radiation chemistry (more properly called high-energy radiation chemistry) is given; some of the guiding ideas of radiation chemistry are summarized; and the present information on the radiolysis of benzene and some related compounds is reviewed. Based on the above, the kinetic stability of C_6H_6 and other aromatic compounds under high energy radiation is understandable in terms of the same resonance factors which would tend to indicate a high thermodynamic stability of C_6H_6, its excited molecule, and the $C_6H_6^+$ ion. The wide distribution of energy both in the excited molecule and in the ion tends to stabilize them until they can undergo collisions in which they are partially deactivated. The liquid state seems to afford better conditions for such deactivation and kinetic stability, as might be expected from the work of Franck and Rabinowitsch. 28 references.

197 Reactions in Aqueous Solutions, by F. H. Krenz. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 192-199, 1947.

The effects of various kinds of radiation on aqueous systems is given. The heavy particles are more effective per Mev in producing a chemical change than either X or gamma radiation. In pure water, free from air, the chemical effect of radiation is the production of hydrogen peroxide and hydrogen enriched electrolytic gas. In the beginning hydrogen peroxide and hydrogen are formed in equal amounts, then the rate of evolution of hydrogen peroxide falls off until a steady-state concentration is reached. Thereafter, hydrogen and oxygen are evolved according to the ratio of their abundance in water.

(Cont'd on next page)

RADIOCHEMISTRY

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Hydrogen peroxide concentration is dependent upon the pH of the water; upon the presence of dissolved substances. Dissolved oxygen increases the initial rate of formation of hydrogen peroxide and its steady-rate concentration. Dissolved halide ions increase the rate of formation of hydrogen-peroxide. No molecular halogen is evolved. In aqueous solutions containing oxidizing solutes, the solute is reduced and an oxygen enriched gas accumulates; in aqueous solutions containing reducing solutes, the solute is oxidized and hydrogen enriched gas accumulates. 12 references.

198 Slow-Electron Reactions, by J. D. Devins. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 200-204, 1947.

Chemical reactions induced by slow electrons are discussed. The theoretical background and this limitations of the methods used are considered. Primary processes producing reactive ions or molecules by means of slow electrons, and secondary processes involving the chemical reactions of these ions and molecules are reviewed.

RADIOGRAPHY

199 One-Millionth Second Radiography and Its Development, by Charles M. Slack and Louis F. Ehrke. ASTM Bulletin, p. 59-68, January 1948.

Discusses the great reduction in exposure times which has been made since Roentgen's period and particularly the latest development which permits radiographs to be made through reasonable thicknesses of metal in one-millionth of a second. 11 references.

RADON

200 Measurements on the Radon Content of Groundwater, by P. J. Hoogteijling, G. J. Sizoo, and J. L. Yntema. Physica 14, p. 73-80, April 1948.

From eight experimental borings in various parts of the country 37 water samples were taken from strainers placed at depths, varying from 5 to 200 meters. The radon content and the chlorine content of these water samples, as well as the radioactivity of ground samples from the neighbourhood of the strainers was determined. The radon content shows in general a marked decrease with the depth. No correlation of the radon content with the chlorine content or with the radioactivity of the ground could be detected. The presence of a layer of clay or loam tends to increase the radon content of the water beneath it. The mean radon content of the ground water amounts to about 5% of the equilibrium value corresponding to the mean radium content of the bottom. The various factors influencing the radon content of the groundwater are discussed.

RARE EARTHS

201 The Absorption and Fluorescence Spectra of Bivalent Europium Ion in Crystals, by Simon Freed and Seymour Katcoff. Physica 14, p. 17-24, January 1948. (MDDC - 1228).

Although bivalent europium ion (Eu^{++}) and trivalent gadolinium ion (Gd^{+++}) are isoelectronic, there is no resemblance in their spectra either as regards intensity or structure. Instead of the sharp spectrum of Gd^{+++}, even at room temperature the spectrum of Eu^{++} consists, both in absorption and in fluorescence, of broad bands which show signs of an underlying discreteness at liquid air temperatures and at the temperature of liquid hydrogen become resolved into lines in some regions.

The spectrum of Eu^{++} in crystals is perhaps one hundred to one thousand times as intense as the spectrum of the gadolinium ion. To obtain transmission, the bivalent salts were greatly diluted to form mixed crystals with the corresponding colorless strontium salt. In contrast with the spectra of Gd^{+++}, the spectra of Eu^{++} are rich in vibrational structure, with an interval 215 cm^{-1} as especially prominent, in the anhydrous chloride. The spectra of Eu^{++} are also exceptional in their strong dependence on the crystalline environment about the europium ions. That is, different salts of bivalent europium differ widely in the character of their spectra in contrast with the typical behavior of rare earths. The chief feature many of the salts have in common is a strong fluorescence in the ultraviolet.

The character of the spectrum is ascribed principally to transitions between a sharp basic level $^8S_{7/2}$ with the seven "optical" electrons in the 4 f shell and activated states having one of these electrons in a 5d, 6s, 6p, etc., or the lattice.

These are possibilities here that some of the sharp activated states which correspond to those in Gd^{+++} have nearly the same energy as those which have one electron in the outer shells of the ion or in the lattice and thus resonance arises between the "inner" and "outer" states. Some evidence is offered for such radiationless transitions and for transitions to the lattice.

202 Rapid Method for Separation of Yttrium and Lanthanum Studied by Using Radioactive Indicators, by J. Beydon. Comptes Rendus 224, p. 1715-1716, 1947. (In French)

To obtain La from a mixture of Y and La sulphates the solution is concentrated in presence of $_{39}Y^{90}$, the La is precipitated as the double sulphate of K and La, and the precipitate is washed with saturated K_2SO_4, dissolved in dilute HNO_3, reprecipitated as hydroxide or oxalate, and ignited to La_2O_3. The activity of the product indicates the proportion of Y remaining. Repeated treatment will reduce Y to 0.8% of that originally present. To obtain Y, $_{57}La^{140}$ is used as indicator and La is precipitated as the double sulphate of La and Tl. This precipitate contains 2% of the Y originally present and the Y fraction contains 20% of the La originally present. On account of the nearness of the life periods of $_{39}Y^{90}$ and $_{57}La^{140}$ (60 and 40 hours, respectively), the two indicators cannot be used simultaneously.

203 Separation of Cerite Earths by Absorption, Especially the Isotopes Arising from the Fission of Uranium, by R. Lindner. Zeitschrift fur Naturforschung,2a. p. 329-332, 1947.

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RARE EARTHS

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The method of radiometric adsorption analysis has been applied to the investigation of the rare-earth isotopes produced in the fission of U. The product of half-life 13 days can be readily separated from La, so that it cannot be identified with this nucleus. It is probably a Pr isotope, which is confirmed by the fact that it cannot be separated from Pr by adsorption. The adsorption of the 13-day product in comparison with that of Nd, element 61, and Sm was investigated. The radiometric adsorption method provides a more effective and simpler method of separation than others at present in use.

SCIENTIFIC RESEARCH

204 AEC Announces Program of Study in Medicine, Biology. Science News Letter 53, p. 360, June 5, 1948.

Among the various research projects to be conducted under the auspices of the Atomic Energy Commission by various non-government laboratories are: radiation-induced gene and chromosomol mutations in fruit flies and corn; nutrition of tapeworms; isotope-therapy in cancer; and airborne infectious diseases.

205 AEC Progress. Scientific American 178, p. 24, June 1948.

The Atomic Energy Commission has reported several new developments in its program of medical and economic applications of atomic energy. One of them is the use of radioactive cobalt as a supplement to radium in the treatment of cancer. About 200 agricultural studies are under way in which AEC-supplied radioisotopes are employed as tracers. In another project isotopes are to be utilized to determine the effects of radioactivity on plant growth.

The indices which appear in each number of Nuclear Science Abstracts will be cumulated for the semi-annual volume.

TRANSURANIC ELEMENTS

206 Isotopes of the New Element Americium (Atomic Number 95), by L. O. Morgan. AECD - 2040 (BC-73), n.d., decl. June 11, 1948. 77 p. (Disposition as required for use in research, development, or manufacturing work) . For sale by AEC.

Isotopes of a new chemical element have been produced. The atomic number is 95 and the element is one of the members of a second rare-earth series analogous to the well-known lanthanide rare-earth series. Element 95 has been given the name americium and the symbol, Am, following the principle set in the case of europium (element 63), Eu, the analogous element in the lanthanide series.

The tracer chemistry of americium has been studied and reveals that it has a very stable (III) oxidation state which is very similar to the (III) state of the lanthanide elements. A relatively unstable higher oxidation state may be reached, but only under the most favorable conditions.

Am^{241}, the only known beta stable isotope of americium, has been produced by the action of helium ions on U^{238} to form Pu^{241}, which decays by beta particle emission to the desired isotope. Am^{241} emits alpha particles of 5.45 Mev kinetic energy with a half-life of 510 ± 10 years. The disintegration is accompanied by a 60 Kev gamma ray and L X-radiation characteristic of neptunium. Am^{242} has been found to consist of a 17 hour beta-emitting isomer and a long-lived isomer which emits alpha particles to form Np^{238} and possible beta particles to form Cm^{242}. The deuteron bombardment of Pu^{239} and the helium ion bombardment of Np^{237} produce americium activities of 12 hour and 50 hour half-lives, which are tentatively assigned to Am^{239} and Am^{238}, respectively. Both are thought to decay by orbital electron capture. Branching decay by alpha particle emission is shown by Am^{239} with a ratio of 0.001 alpha particles per orbital electron capture.

207 Actinide Series of Chemical Elements, by T. J. Hardwick. Proceedings of the Nuclear Conference on Nuclear Chemistry, Chemical Institute of Canada, p. 44-50, 1947.

It is proposed that the actinide elements presently found in Group III A through Group VIII should be reclassified either as another long period or as a second rare earth group with electrons filling up the 5f orbit. The chemical and physical properties of the transuranic elements neptunium, plutonium, americium, and curium are discussed.

208 Chemistry of Plutonium, by B. G. Harvey, Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 60-67, 1947.

The chemical properties of Pu are described and compared with those of U. A similar paper by the author appeared in Journal of the Chemical Society 188, p. 1010-1021, August 1947.

209 Electrochemistry of Some Actinide Elements, by R. H. Betts. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 68-76, 1947.

The results of polarographic studies on U and Pu are presented, and a schematic polarogram of Pu is given. The present electrochemical knowledge of Pu is confined to Pu^{III}, Pu^{IV}, and Pu^{VI}. Evidence for the existence of Pu^{V} rests on measurements of absorption spectra of mixtures of P^{III}, Pu^{IV}, and P^{VI}, in which small amounts of Pu^{V} are formed. The transitions between these states occur over a range from about +0.75 to −1.1 volts on the H-scale. No reliable estimate has yet been obtained for the

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reduction potential between Pu metal and Pu^{III}. The applications of electrochemical methods in preparative and analytical procedures and in the investigation of the kinetics of oxidation and reduction processes are discussed briefly.

URANIUM

210 The Vapor Pressure of Uranium Halides, by M. E. Mueller. AECD - 2029 (BC-26) n.d., decl. May 28, 1948. 105 p. (To be included in the NNES-MPTS)

It is the purpose of this paper to present a critical review of vapor pressure measurements made on uranium halides which were investigated by the chemistry staff of the University of California Radiation Laboratory in the time interval from February 1943 to July 1946. Measurements made by other groups are included.

With the exception of UF_4, no work was done on uranium fluorides, but this is the only important group omitted from the list of compounds considered. The fluorides have been investigated by the Columbia University group. Vapor pressure measurements are presented and evaluated for UF_4, UCl_3, UCl_4, UCl_6, UBr_3, UBr_4, UCl_3Br, UCl_2Br_2, $UClBr_3$, UBr_3I, and UI_4. Equilibrium decomposition pressure measurements are presented for $UOCl_2$, $UOBr_2$, UI_4, UCl_3I, and UBr_3I. Summaries are given of the vapor pressure equations, melting points, boiling points, triple point pressures, heats of sublimation and vaporization, and of vapor pressures and decomposition pressures.

211 X-Ray Studies of Alpha, Beta, and Gamma Uranium, by A. S. Wilson and R. E. Rundle. AECD - 2046, n.d., decl. June 9, 1948. 8 p. (To be included in the NNES-MPTS)

The three forms of uranium metal, first discovered by heat capacity studies, have been examined by X-ray diffraction.

Alpha uranium, stable to 640°C, is orthorhombic with a unique structure. The structure has been previously described in the literature and is summarized in this paper. Beta uranium, stable from 640°C to 760°C, has been examined both at elevated temperatures and at room temperature. The latter studies were made by quenching solid solutions of uranium containing chromium or molybdenum. Though the structure of beta uranium remains unknown, the observed X-ray powder diagram indicates that the structure is of low symmetry. The positions of the maxima of the beta diagram are listed. Gamma uranium, stable from 760°C to the melting point, is a body centered cubic of structure type A2. The lattice constant is 3.467 ± 0.005 A at room temperature, 3.48 A at 800°C. Gamma uranium can be quenched only if it contains certain other metals in solid solution.

URANIUM

212 Determination of Small Amounts of Uranium by the Polarographic Method, by S. B. Kilner. AECD - 2059 (CHEM S-9), November 30, 1942, decl. June 17, 1948. 2 p. (Disposition as required for use in research, development, or manufacturing work) For sale by AEC.

A method has been published by R. Strubl for determining uranium in the ferric hydroxide precipitate polarographically, which is claimed to be sensitive to 0.1% uranium in ferric hydroxide. It has been found possible to determine approximately 50 micrograms/cc of uranium, and by using enough ferric hydroxide to give a final solution nearly saturated with ferrous chloride, it should be possible to detect as little as one part in ten thousand of uranium in ferric hydroxide and estimate it to within 20% or so. The presence of 10 micrograms/cc of uranium can be noticed if the run is carefully made, which means that one thousandth of a per cent of uranium can be detected in the ferric hydroxide precipitate.

213 The Low Temperature Heat Capacities, Enthalpies, and Entropies of UF_4 and UF by Ferdinand G. Brickwedde, Harold J. Hoge, and Russell B. Scott. Journal of Chemical Physics 16, p. 429-436, May 1948. (MDDC - 368)

The heat capacity of UF_4 has been measured from 20° to 350°K and that of UF_6 from 14° to 370°K. Molar heat capacities have been tabulated at 5-degrees intervals and extrapolated to 0°K. From them the entropies and enthalpies of the compounds have been found by integration and tabulated. The triple point temperature of UF_6 was found to be 337.212°K (64.052°C) and the heat of fusion was found to be 19,193 joules per mole.

214 Preparation and Structure of the Carbides of Uranium by L. M. Litz, A. B. Garrett, and F. C. Croxton. Journal of the American Chemical Society 70, p. 1718-1722, May 1948.

Uranium dicarbide, UC_2, and the previously unreported monocarbide, UC, have been prepared by several methods. The crystal lattice constants have been determined for the two structures, and X-ray diffraction evidence is presented which indicates that the monocarbide has the sodium chloride type of structure, and the dicarbide has the calcium carbide type of structure.

The lattice constants observed are: UC, $a_o = 4.995A$; $UC_2 = 3.54A$; $c_o = 5.99A$.

215 The Vapor Pressure of Uranium Hexafluoride, by B. Weinstock and R. H. Crist. Journal of Chemical Physics 16, p. 436-441, May 1948. (MDDC - 1295)

The vapor pressure of uranium hexafluoride, UF_6 has been measured from 273°K to 358°K. The measurements were made by a null method in an all metal apparatus with a brass sylphon bellows. The data are represented by the equations:

Solid—vapor, $\log_{10} P(\text{mm Hg}) = -3.77962 \log_{10} T - (3123.479/T) \pm 21.87103$,
Liquid—vapor, $\log_{10} P(\text{mm Hg}) = -3.72662 \log_{10} T - (2065.679/T) \pm 18.60033$.

The constants in the equations were adjusted so that the equations would give the same heat of fusion and triple-point temperature as was determined by Brickwedde, Hoge, and Scott. The vapor pressure at the triple point is 1133±7 mm. The sublimation point at which the vapor pressure is 1 atmosphere

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is 56.5°C. The heat of vaporization has been calculated using the Berthelot equation to obtain the vapor volume. From this and the entropies measured by Brickwedde, the absolute entropy of the gas has been calculated.

216 Vibrational Spectrum and Thermodynamic Properties of Uranium Hexafluoride Gas, by Jacob Bigeleisen and Maria Goeppert Mayer. Journal of Chemical Physics 16, p. 442-445, May 1948. (MDDC - 1181)

The Raman spectra of liquid UF_6 and of UF_6 dissolved in C_7F_{16} have been photographed. Three Raman lines are found for UF_6 at 200, 511, and 656 cm^{-1}. The infra-red spectrum of the gas has been obtained in the region between 2 and 17μ. A vibrational assignment of all the fundamental frequencies is made on the basis of the regular octahedral model. The calculated infra-red active overtones are in good agreement with experiment. Using 2.0A as the U-F distance from electron diffraction measurements, the entropy, heat capacity and $-(F^\circ - E_o^\circ/T)$ are calculated from 100°K to 1000°K for the gas. The calculated and experimental entropies are in good agreement.

X-RAYS

217 Absorption of X-Rays in Air, by Frank H. Day and Lauriston S. Taylor. Journal of Research of the National Bureau of Standards 40, p. 393-399, May 1948.

Studies have been undertaken to determine the absorption in air of X-rays produced by voltages from 10 to 200 kv (constant potential) for various initial filtrations. A free-air ionization chamber on tracks is used to obtain absorption data over a 150-cm distance. No appreciable change in quality of X-rays is observed in this distance because of the air absorption. Hence, for short distances, effective air absorption coefficients for heterogeneous X-rays of various qualities have been determined.

218 Blocking the X-Rays. National Safety News 56, p. 26-27, p. 75-77, 1947.

The use of concrete as a barrier against million-volt wide-beam X-rays at the National Bureau of Standards is discussed.

219 Roentgen-Ray Calibration of Photographic Film Exposure Meter, by L. J. Deal, J. H. Robertson, and F. H. Day. American Journal of Roentgenology and Radium Therapy 59, p. 731-736, May 1948.

A series of films were exposed to calibrated beams of radiation over the range of 10 to 1,400 kv, with filtration increasing as the potential was raised. Film densities were then obtained by means of an Ansco-Sweet densitometer and the relation between exposure and film blackening determined. The results are tabulated and plotted. The potential dependence of the Victoreen pocket-type ionization chamber was also determined.